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(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing recepticle.

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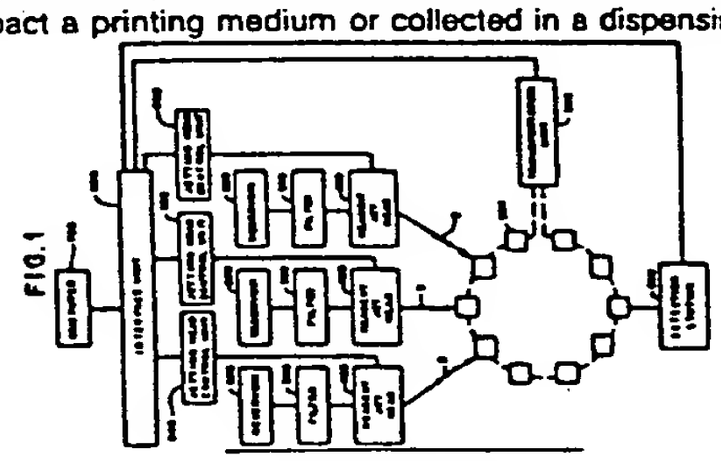

FIG.1

APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the define volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when developed, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproduceable minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

SUMMARY OF THE PRESENT INVENTION

The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid recepticle. If desired, additional droplets may be deposited in the recepticle or the recepticle aligned with an additional jetting tube for receiving an additional reagent fluid.

An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents do not in general have to be specially adapted for use with the present invention.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezeo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply type 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the differing constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the orifice causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satelite droplet. However, even if satelite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the pres ent invention overcomes this disadvantage.

In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*, HIGHER*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a reservoir R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifer U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V++. A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V++ is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and nega tive voltage reference signal inputs REF(+). REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT* are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the invert ing input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V+ +.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation aand duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER* signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER* signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT* signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is ANDed with the closed enable switch S1 and the series of print pulses PRT'. The result of the AND operation is the application of the PRT' pulses to the pulse generator circuit 530.

The PRT' signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT'. The two outputs IOUT, IOUT' are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U28 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satelite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the momement of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the tranducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schem atically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connec tions to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400" . The jetting head 400" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409" and screws, not shown. When assembled, the housing sections 404", 402" form a T-shaped supply channel 410" .

In operation, the jetting head 400" functions in a manner similar to the jetting head 400. The jetting head 400" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430" allowing the jetting tube 432" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11B. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Bellenca, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):
Fluid viscosity range: 1 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm
Printing (continuous mode):
Fluid viscosity range: up to 50 centipoises
Fluid surface tension: not measured
Dispensing (drop on demand mode):
Fluid viscosity range: 2 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satelite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satelite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found especially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
R39,45-48,57, 58	RES.10KOHM½WATT5%C.F.	
R66	RES.150OHM½WATT5%C.F.	
R3	RES.15KOHM½WATT5%C.F.	
R34	RES.16KOHM½WATT5%C.F.	
R50	RES.2.4KOHM½WATT1%M.F.	DALE RL0792-42G
R13,23,36,40, 41	RES.2.4KOHM½WATT5%C.F.	
R56	RES.20KOHM½WATT5%C.F.	
R8	RES.2200HM½WATT5%C.F.	
R6	RES.270HM1WATT5%C.C.	
R7,12,25	RES.2KOHM½WATT5%C.F.	
R67	RES3.6KOHM½WATT5%C.F.	
R51,53	RES.3.9KOHM½WATT5%C.F.	
R29	RES.300KOHM½WATT5%C.F.	
R61	RES.30KOHM½WATT1%M.F.	DALE RL0793-03G
R15-18,26-28, 54,55,64	RES.4.7KOHM½WATT5%C.F.	
R62	RES.45.3KOHM½WATT1%M.F.	DALE RN55D4532F
R30,33	RES.470HM½WATT5%C.F.	
R21	RES.4700HM½WATT5%C.F.	
R19	RES.47KOHM½WATT5%C.F.	
R35	RES.5100HM½WATT5%C.F.	
R43	RES.6.2KOHM½WATT5%C.F.	
R60	RES.7.5KOHM½WATT5%C.F.	
R37	RES.75KOHM½WATT5%C.F.	
R9	RES.76KOHM½WATT1%M.F.	DALE RN60D7682F
R11	RES.8200HM½WATT5%C.F.	
U2,11,14,16,22	RES.DIP NETWRK.47KOHM	CT9 761-1R47K
C21,41,45	CAP.AXIAL1MF@250VDC	MALLORY #TC56
C24	CAP.AXIAL220MF@250VDC	MALLORY LP22192-50C7P3
C10	CAP.AXIAL ALUM ELEC. 4700 OMF@25VDC	MALLORY TCG472U025NIC
C1,2,3,55,60	CAP.RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
C53	CAP.RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105K035AS
C36	CAP.RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350E566MC10AS

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP.RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP.RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP.RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C6	CAP.RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30,35,37	CAP.RADIAL 25U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4,7	CAP.RADIAL 25U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4,5,6,9,11-19, 22,23,25-28 C31-34,37,42,43 47,48,50-52 C56,58,59	CAP.RADIAL 25U MLC .22MF@50VDC	KEMET C322C224M5U5CA
C46	CAP.VARI.2-12PF.	JOHANSEN #9626
CR7,8,9,10, 11,12,17	DIODE SIL.	ITT.FAIRCHLD.1N4148
CR1,2,3,4	DIODE SIL.FAST	GENL.INST.EGP10D
CR5	DIODE SIL.FASTHIVOLT	GENL.INST.UF4007
CR6,13,15	DIODE SIL.REF.2,500VDC	NATL.SEMI-LM3852-2.5
CR14,16	DIODE SIL.ZENER3.8V.25WATT	MOTOROLA 1N4622A
U6,13,15,17	SWITCH 8 POSITION DIP	CTS 206-8
Q2,9,12	TRANSTOR.COMMON NPN	MOTOROLA 2N2222A
Q8,10,11	TRANSTOR.COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR.HIVOLTHIFREQ.NPN	MOTOROLA MPSU10
Q7	TRANSTOR.HIVOLTHIFREQ.PNP	MOTOROLA MPSU60
Q1	TRANSTOR.HIVOLTHI.NPN	TI,MOTOROLATIP48
Q3,14	TRANSTOR.HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR.HIVOLTPNP	MOTOROLA MJE5731
U5,27	IC 1-SHOT 74HC221	NATL.SEMI MM74HC221N
U23,26	IC 1-SHOT 74LS221	NATL.SEMI DM74LS221N
U7-10	IC COMPARATOR 74HC688	NATL.SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL.SEMI DAC0800LCN
U24,25	IC COUNTER 74HC193	NATL.SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 724
U4	IC OC DRIVER SN7406	NATL.SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
U12,29,31,32	IC OP AMP LF256	NATL.SEMI LF256H
U18,19,20,21	IC OPTO ISOLATOR	HEWLTT-PCKRD HCPL2300
R24,42,63	POT100KOHM½WATT10%	BOURNS 3622-1-104
R38,49,52	POT10KOHM½WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM½WATT10%	BOURNS 3622W-1-253
R14,31	POT2KOHM½WATT10%	BOURNS 3622W-1-202

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
VRI	REGULATOR 5VDC	NATL.LM340T-5.0
R10	RES.1MEGOHM½WATT5%C.F.	
R2,4	RES.1.2KOHM½WATT5%C.F.	
R32	RES.1.6KOHM½WATT5%C.F.	
R44	RES.1.8KOHM½WATT5%C.F.	
R1	RES.10MEGOHM½WATT5%C.F.	
R5,R22	RES.100HM½WATT5%C.F.	
R65	RES.100KOHM½WATT5%C.F.	
R59	RES.10KOHM½WATT1%M.F.	DALE RN55D1002F
R100	RES.2700HM	
R101,108	RES.4700HM	
R102,103 106,109,110	RES.1KOHM	
R104	RES.47000HM	
R105	POT.100KOHM	
R107	POT.10KOHM	
R111,113	RES.2200HM	
R112	RES.220HM	
R114,115	RES. 470HM	
C100	CAP.10MF035 VFC	
C108	CAP.10000 PF	
D100	DIODE	1N4148
Q100,105	TRANSTOR	2N2222
Q101,102	TRANSTOR	2N3906
Q103,104	TRANSTOR	2N3904
U100,U108	IC I-SHOT	74LS123
U103,104 105,106	IC INVERTOR	74LS04
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

```
Offset  Data   Source Line

0030    0006   REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Calibration' $LINESIZE: 132
0030    0006   'MODULE  - "REACAL"
0030    0006   '
0030    0006   'AUTHOR  - R. A. Enevold
0030    0006   '
0030    0006   'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006   'REVISION - 2.0 07-01-86 RAE MicroFab modifications
0030    0006   '         - 1.0 02-11-86 RAE Creation of initial code
0030    0006   '
0030    0006   'SYSTEM  - This code can only be compiled by the BASCOM
0030    0006   '          COMPILER, it will not run under the INTERPRETER!!
0030    0006   '
0030    0006   'DESCRIPTION:
0030    0006   '       The reagent calibrate module presents a menu with 12 items arranged
0030    0006   '       in 3 columns of 4 rows.  The arrow keys allow movement around the
0030    0006   '       table, the + and - keys increment or decrement values in the first
0030    0006   '       column, and the enter key executes commands in the third column.
0030    0006   '       The second column is an array of ASCII strings representing reagent name,
0030    0006   '       concentration, density, and viscosity.  The values entered in column one
0030    0006   '       are drop frequency, pulse width, strobe delay, and nozzle number.
0030    0006   '       The commands in the third column are start/stop, load, save, and exit.
0030    0006   '
0030    0006   'DATA DICTIONARY
0030    0006   '       MENU%          Pointer to which menu item is active (0-11)
0030    0006   '       MENU$(17,1)    Array for strings used to display the menu
0030    0006   '       MENU(17,4)     Array for numbers in the menu display
0030    0006   '       DIFF%          Differential to move MENU% at arrow key input
0030    0006   '       TYPE%          Pointer set during main scan to direct action
0030    0006   '       KEYBUF$        Storage for string input from menu display
0030    0006   '       A$             Destination for single keystroke inputs
0030    0006   '       FILE$          String where filename is built for reagent data file
0030    0006   '       REANAME$       String where reagent name is stored
0030    0006   '       RX             Row to display special graphics character in menu
0030    0006   '       CX             Column to display special graphics character in menu
0030    0006   '       MX             Special graphics character is read into here
0030    0006   '       OLD.AMP.VALUE% Integer value for setting pulse amplitude
0030    0006   '       BIG.VAL%       Value set to digital port 0 to inc/dec amplitude
0030    0006   '
0030    0006   SUB REAGENT.CALIBRATE STATIC
0047    0006
0047    0006           DIM MENU$(17,1),MENU(17,4)
0048    01FE
0048    01FE           GOSUB INITIALIZE:       'read init. values and set screen
004E    01FE
004E    01FE           WHILE TYPE% <> 1
0059    0200
0059    0200             TYPE% = 0
0060    0200             A$ = ""
006A    0204           WHILE A$ = ""
0079    0204             A$ = INKEY$
0083    0204             IF ACTIVE% = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
00AD    0208           WEND
00B0    020A
```

```
 Offset  Data    Source Line

0080    020A            IF A$ = CHR$(13) THEN TYPE% = 1:                'execute (cr)
00CA    020A            IF A$ = "+" THEN TYPE% = 2:                     'increment variable
00E0    020A            IF A$ = "-" THEN TYPE% = 3:                     'decrement variable
00F6    020A            IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 4:      'up arrow key
011B    020A            IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 5:      'down arrow key
0140    020A            IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 6:      'left arrow key
0165    020A            IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 7:      'right arrow key
018A    020A            IF A$ > CHR$(47) AND A$ < CHR$(123) THEN TYPE% = 8:' ascii 0 - z
01C2    020A
01CZ    020A            ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB    020A
01DB    020A          WEND
01DF    020A          TYPE% = 0
01E6    020A
01E6    020A          EXIT SUB
01EA    020A    REM $PAGE
```

```
Offset  Data   Source Line

01EA    0202   '********** SUBROUTINES FOR THIS MODULE **********
01EA    0206
01EA    0208   T1:             '(cr) execute command
01EF    0208           IF MENUI < 12 THEN TYPE1 = 0:RETURN:    'exit to print menu, no action
0205    020C           ON MENUI - 11 GOSUB T1A, T1B, T1C, T1D
021A    020C           IF MENUI < 15 THEN TYPE1 = 0
022C    020C           RETURN
0230    020C
0230    020C   T1A:            'start/stop drop flow
0235    020C           IF MENU$(12,0) = "START" THEN GOSUB START.INK
025A    020C           IF MENU$(12,0) = "STOP " THEN GOSUB STOP.INK
027F    020C           MENU$(12,0) = TEMP$
029A    0210           COLOR 0,7:GOSUB DISPMENU
02AC    0210           RETURN
02B0    0210
02B0    0210   START.INK:
02B5    0210           TEMP$ = "STOP "
02BF    0210           CALL DOT.ON:            'in module PCI
02CB    0210           LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
02F1    0210           ACTIVE1 = 1
02FB    0210           RETURN
02FC    0210
02FC    0210   STOP.INK:
0301    0210           TEMP$ = "START"
0308    0210           CALL DOT.OFF:           'in module PCI
0317    0210           LOCATE 17,71:COLOR 15,0:PRINT "       ";
033D    0210           ACTIVE1 = 0
0344    0210           RETURN
0348    0210
0348    0210   T1B:            'load reagent profile
0349    0210           IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
0391    0210
0393    0210           GOSUB SEARCH
0397    0210
0397    0210           IF I1 < (READNUM + 1) THEN GOTO FOUND
03A8    0214           LOCATE 25,10-LEN(MENU$(6,1))/2:PRINT MENU$(6,1)" not Found";
0404    0214           GOSUB ANYKEY:   'wait for a keyhit
0408    0214           RETURN
040E    0214
040E    0214   FOUND:
0413    0214           FILE$ = RIGHT$(STR$(I1),LEN(STR$(I1))-1) + "REA.DAT"
0437    0218           OPEN FILE$ FOR INPUT AS #1:     'set pattern data file for read
0448    0218           INPUT #1,MENU(0,0):     'read frequency
0468    0218           INPUT #1,MENU(1,0):     'read amplitude
0488    0218           INPUT #1,MENU(2,0):     'read stroke delay
04AE    0218           INPUT #1,MENU(3,0):     'read pulse width
04D1    0218           INPUT #1,MENU(4,0):     'read rise time
04F4    0218           INPUT #1,MENU(5,0):     'read fall time
0519    0218
0519    0218           INPUT #1,MENU$(7,1):    'read concentration
0538    0218           INPUT #1,MENU$(8,1):    'read density
0541    0218           INPUT #1,MENU$(9,1):    'read viscosity
0585    0218           INPUT #1,MENU$(10,1):   'read surface tension
05A9    0218
```

6 Reagent Jet Printer
Reagent Calibration

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data   Source Line

 05A9   0218          CLOSE #1:       'done with data file
 05B0   0218
 05B0   0218          OPEN "SEADEF.RJP" FOR OUTPUT AS #1
 05B0   0218          PRINT #1,FILES:                 'save filename is default file
 05C2   0218          PRINT #1,MENUS(6,1):    'save the directory name as well
 05D2   0218          CLOSE #1
 05F4   0218          GOSUB DISP.PARMS:       'show all parameters
 05FB   0218          RETURN
 0601   0218
 0605   0218          'save reagent profile
 0605   0218    TIC:  IF MENUS(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
 060A   0218          OPEN "READIR.RJP" FOR INPUT AS #1
 064E   0218          INPUT #1,REANUM%
 065F   0218          CLOSE #1
 0671   0218          IF REANUM% < 80 THEN GOTO SAVE.REA
 0678   0218          LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
 0687   0218          GOSUB ANYKEY:RETURN
 06A1   0218
 06A8   0218    SAVE.REA:
 06B0   0218          GOSUB SEARCH
 0686   0218          IF I% > REANUM% THEN GOTO SAVEREA1
 06C7   0218          REANUM% = I%
 06CE   0218          COLOR 15,0
 06DA   0218          LOCATE 25,1:PRINT MENUS(6,1);" already exists. Replace it with new values? ";
 070C   0218          A$ = ""
 0716   0218          WHILE A$ = ""
 0725   0218                A$ = INKEY$
 072F   0218          WEND
 0732   0218          LOCATE 25,1:PRINT SPACE$(79);
 074F   0218          IF A$ = "Y" OR A$ = "y" THEN GOTO REPLACE
 0778   0218          RETURN
 077C   0218
 077C   0218    SAVEREA1:
 0781   0218          KILL "READIR.OLD":      'delete old backup directory
 0788   0218          NAME "READIR.RJP" AS "READIR.OLD":      'save old directory
 0792   0218          OPEN "READIR.OLD" FOR INPUT AS #1
 07A3   0218          OPEN "READIR.RJP" FOR OUTPUT AS #2:     'set up new dir
 07B5   0218
 07B5   0218          INPUT #1,REANUM%:       'read number of dir entries
 07C7   0218          REANUM% = REANUM% + 1:  'increase by 1
 07D0   0218          WRITE #2,REANUM%:       'save in new directory
 07E1   0218
 07E1   0218          FOR I=1 TO REANUM% - 1
 07FA   021C              LINE INPUT #1,A$:   'read entry from old dir
 0807   021C              PRINT #2,A$:        'write entry in new directory
 0817   021C          NEXT I
 0832   0220
 0832   0220          CLOSE #1
 0839   0220
 0839   0220          PRINT #2,MENUS(6,1):    'write new entry to new directory
 0853   0220          CLOSE #2:       'done with directory
 0862   0220
 0862   0220    REPLACE:
 0867   0220          FILE$ = RIGHT$(STR$(REANUM%),LEN(STR$(REANUM%))-1) + "REA.RJP"
 0888   0220
```

```
 Offset  Data    Source Line

0888  0220          OPEN FILES FOR OUTPUT AS #1:    'create new pattern data file
0890  0220          WRITE #1,MENU(0,0):     'store frequency
0898  0220          WRITE #1,MENU(1,0):     'store amplitude
08A0  0220          WRITE #1,MENU(2,0):     'store strobe delay
08A9  0220          WRITE #1,MENU(3,0):     'store pulse width
08B1  0220          WRITE #1,MENU(4,0):     'store rise time
08BE  0220          WRITE #1,MENU(5,0):     'store fall time
08C2  0220
08C2  0220          WRITE #1,MENU(7,1):     'store concentration
08C4  0220          WRITE #1,MENU(8,1):     'store density
08A6  0220          WRITE #1,MENU(9,1):     'store viscosity
08CB  0220          WRITE #1,MENU(10,1):    'store surface tension
08EA  0220
08EA  0220          CLOSE #1:       'done with data file
08F1  0220
08F1  0220          OPEN "README.RJP" FOR OUTPUT AS #1
0A03  0220          PRINT #1,FILE$:             'save filename in default file
0A13  0220          PRINT #1,MENU$(6,1):    'save the directory name as well
0A35  0220          CLOSE #1
0A3C  0220          RETURN
0A40  0220
0A40  0220    SEARCH:
0A45  0220          OPEN "README.RJP" FOR INPUT AS #1
0A56  0220          INPUT #1,NEWNUM:        'read number of patterns in dir
0A68  0220          I% = 1:                 'set entry pointer
0A6F  0220
0A6F  0220    SLOOP:
0A74  0220          LINE INPUT #1,A$:       'read next pattern name from dir
0A81  0220          IF A$ = MENU$(6,1) THEN GOTO SEARCH.DONE:       'compare name with dir entry
0A85  0220          I% = I% + 1
0AAE  0220          IF I% < (NEWNUM + 1) THEN GOTO SLOOP:'check for done
0AC1  0220    SEARCH.DONE:
0AC6  0220          CLOSE #1
0ACD  0220          RETURN
0AD1  0220
0AD1  0220    T10:          'return with no change to exit reagent calibrate
0AD6  0220          PRINT #3,"UH";
0AE6  0220          CLOSE #3:'      close com channel
0AEB  0220          RETURN
0AF1  0220
0AF1  0220    T2:           'process "+" key
0AF6  0220          IF MENUI > 5 THEN RETURN
0B05  0220          NEWTIME = TIMER
0B0F  0224          DELTATIME = NEWTIME - OLDTIME
0B1F  022C          OLDTIME = NEWTIME
0B29  022C          IF DELTATIME > 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
0B48  022C          IF MULTI > 100 THEN MULTI = 100
0B58  022C          MENU(MENUI,0) = MENU(MENUI,0) + MENU(MENUI,3) * MULTI:  'add increment
0B9F  022C          IF MENU(MENUI,0) > MENU(MENUI,1) THEN MENU(MENUI,0) = MENU(MENUI,1):    'check max value
0C06  022E          COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0C1D  022E
0C1B  022E    T3:           'process "-" key
0C22  022E          IF MENUI > 5 THEN RETURN
0C31  022E          NEWTIME = TIMER
```

```
Offset  Data    Source Line

0C3B    022E            DELTATIME = NEWTIME - OLDTIME
0C48    022E            OLDTIME = NEWTIME
0C55    022E            IF DELTATIME > 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
0C77    022E            IF MULTI > 100 THEN MULTI = 100
0C89    022E            MENU(MENUI,0) = MENU(MENUI,0) - MENU(MENUI,3) * MULTI:  'sub increment
0CCB    022E            IF MENU(MENUI,0) < MENU(MENUI,2) THEN MENU(MENUI,0) = MENU(MENUI,2):    'check min value
0D32    022E            COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0D49    022E
0D49    022E    T4:             'process up arrow key
0D4E    022E            IF MENUI MOD 6 = 0 THEN RETURN:             'in top row already
0D63    022E            DIFFI = -1:GOSUB NEWMENU:RETURN:        'move pointer up one
0D74    0230
0D74    0230    T5:             'process down arrow key
0D79    0230            IF MENUI MOD 6 = 5 THEN RETURN:             'in bottom row already
0D8F    0230            DIFFI = 1:GOSUB NEWMENU:RETURN:             'move pointer down one
0DA0    0230
0DA0    0230    T6:             'process left arrow key
0DA5    0230            IF INT(MENUI / 6) = 0 THEN RETURN       'in left column already
0DC5    0230            DIFFI = -6:GOSUB NEWMENU:RETURN:        'move pointer one left
0DD6    0230
0DD6    0230    T7:             'process right arrow key
0DDB    0230            IF INT(MENUI / 6) = 2 THEN RETURN       'in right column already
0DFE    0230            DIFFI = 6:GOSUB NEWMENU:RETURN:             'move pointer one right
0E0F    0230
0E0F    0230    T8:             'input keys into KEYBUF$ until (cr) is entered
0E14    0230            IF MENUI > 10 THEN RETURN
0E23    0230            LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E35    0230            KEYBUF$ = A$
0E3F    0234            WHILE A$ <> CHR$(13)
0E72    0234                    LOCATE 25,47:PRINT SPACE$(15);
0E8F    0234                    LOCATE 25,47:PRINT KEYBUF$;
0EA9    0234                    A$ = ""
0EB3    0234                    WHILE A$ = ""
0EC2    0234                            A$ = INKEY$
0ECC    0234                            IF ACTIVE1 = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
0EF6    0234                    WEND
0EF9    0234                    IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
0F38    0234                    IF A$ > CHR$(31) AND LEN(KEYBUF$) < 15 THEN KEYBUF$ = KEYBUF$ + A$
0F75    0234            WEND
0F79    0234
0F79    0234            IF MENUI > 5 THEN GOTO STORESTRING
0F88    0234
0F88    0234            TEMP = VAL(KEYBUF$)     'temp has value of keys input
0F98    0238
0F98    0238            'round off temp according to step size in menu array
0F98    0238            TEMP = INT((TEMP / (MENU(MENUI,3)) + .5) * MENU(MENUI,3)
0FB1    0238
0FB1    0238            'test TEMP for maximum and minimum values in menu array
0FB1    0238            IF TEMP > MENU(MENUI,1) THEN TEMP = MENU(MENUI,1)
1019    0238            IF TEMP < MENU(MENUI,2) THEN TEMP = MENU(MENUI,2)
104F    0238
104F    0238            'insert new value into menu array and update screen
104F    0238            MENU(MENUI,0) = TEMP
1048    0238            LOCATE 25,30:PRINT SPACE$(40);
```

```
   Offset  Data    Source Line

10 1088    0238          COLOR 0,7:GOSUB DISPMENU
   108A    0238          RETURN
   108E    0238
   108E    0238    SINGLESTRING:
   1083    0238          MENU$(MENUT,1) = KEYBUF$
   108F    0238          LOCATE 25,30:PRINT SPACE$(40);
15 109C    0238          COLOR 0,7:GOSUB DISPMENU
   10EE    0238          RETURN
   10F2    0238
   10F2    0238    PEN.DOWN:
   10F7    0238          DOWNTIME = TIMER + 1
   1107    0238          PRINT #3,"D";
20 1117    0238          RETURN
   1118    0238
   1118    0238    ANYKEY:
   1120    0238          LOCATE 25,64:PRINT "Strike any key..";
   113A    0238          A$ = ""
   1144    0238          WHILE A$ = ""
25 1153    0238                A$ = INKEY$
   115D    0238          WEND
   1160    0238          LOCATE 25,1:COLOR 15,0:PRINT SPACE$(79);:COLOR 15,1
   1196    0238          RETURN
   119A    0238
   119A    0238    MENUMENU: 'write old item in yellow, point to and highlight new item
30 119F    0238          COLOR 14,0:GOSUB DISPMENU
   11B1    0238          MENUT = MENUT + DIFFT
   11BD    0238          IF MENUT = 11 THEN MENUT = 10
   11CF    0238          IF MENUT > 15 THEN MENUT = 15
   11E1    0238          COLOR 0,7:GOSUB DISPMENU:RETURN
   11F7    0238
35 11F7    0238    INITIALIZE:
   11FC    0238          'change to second screen and display messages
   11FC    0238          SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
   1240    0238          LOCATE 12,33:PRINT "Please Wait..."
   125A    0238
   125A    0238          'initialize variables
40 125A    0238
   125A    0238          ACTIVE% = 0%'   not printing
   1261    0238
   1261    0238          'initialize plotter com channel
   1261    0238
   1261    0238          OPEN "COM1:2400,N,8,2" AS #3
45 1273    0238          PRINT #3,"I;IW[CS,EFV1,R";
   1283    0238
   1283    0238          'initialize digital port
   1283    0238          SCRX = 4
   128A    023A          CALL DIGITAL.OUT(SCRX)
   129A    023A          SCRX = 0
50 12A1    023A          CALL DIGITAL.OUT(SCRX);         'pulse reset line to set amplitude to 0V.
   12B1    023A          SCRX = 4
   12B8    023A          CALL DIGITAL.OUT(SCRX)
   12C8    023A
   12C8    023A          'set hardware pulse width
55 12C8    023A          CALL SET.DOT.WIDTH(5)    'in module PCI
```

```
  Offset- Data   Source Line

70 120E  0230
   120E  0230          'initialize mouse arrays
   120E  0230          RESTORE ARROWDATA
   120E  0230          FOR I1=0 TO 17
   1263  0230                READ MENUS(I1,0),MENUS(I1,1)
   12E3  0230                READ MENU(I1,1),MENU(I1,2),MENU(I1,3),MENU(I1,4)
   1318  0230          NEXT I1
75 137C  0230
   138F  0230
   138F  0230          'set default reagent values
   138F  0230
   138F  0230          MENU(0,0) = 2000:          'frequency
   13A8  0230          MENU(1,0) = 0:             'amplitude
20 13C4  0230          MENU(2,0) = 1:             'strobe delay
   13E0  0230          MENU(3,0) = 090:           'pulse width
   13FC  0230          MENU(4,0) = 070:           'rise time
   1418  0230          MENU(5,0) = 070:           'fall time
   1436  0230
   1436  0230          MENU(6,0) = 0:             'ozone
25 1452  0230          MENU(7,0) = 0:             'concentration
   146E  0230          MENU(8,0) = 0:             'density
   148A  0230          MENU(9,0) = 0:             'viscosity
   14A6  0230          MENU(10,0) = 0:                    'surface tension
   14C2  0230
   14C2  0230          OLD.AMP.VALUE% = 0         'initial value of 0 volts
30 14C9  0230
   14C9  0230          'change active displayed screen to first screen to draw and display parameters
   14C9  0230
   14C9  0230          SCREEN 0,0,0,1:CLS
   14E6  0230
   14E6  0230          COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
35 1507  0230          COLOR 9
   150E  0230          FOR I=2 TO 79
   1518  0230                LOCATE 3,I:PRINT "D";:LOCATE 5,I:PRINT "D";:LOCATE 19,I:PRINT "D";
   156F  0230          NEXT I
   158A  0230          FOR I=4 TO 18
   1594  0230                LOCATE I,1:PRINT "3";:LOCATE I,2B:PRINT ":";:LOCATE I,69:PRINT ":";:LOCATE I,80:PRINT "3";
40 16D8  0230          NEXT I
   1626  0230          RESTORE TABLE
   1628  0230          FOR I=1 TO 12
   1657  0230                READ X1,C1,X2:LOCATE X2,C1:PRINT CHR$(X1);
   1668  0244          NEXT I
   1685  0244
45 1685  0244          'print three headings and instructions
   1685  0244          COLOR 10,0
   1691  0244          LOCATE 4,7:PRINT "DROP PARAMETERS";
   16A8  0244          LOCATE 4,39:PRINT "REAGENT PARAMETERS"
   16C5  0244          LOCATE 4,71:PRINT "COMMANDS";
   160F  0244
50 160F  0244          COLOR 7:LOCATE 21,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
   1729  0244          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
   1768  0244          LOCATE 22,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
   178E  0244          COLOR 7:PRINT" to scroll current value up or down";
   1702  0244          LOCATE 23,26:PRINT "Use ";:COLOR 15:PRINT "ST";:COLOR 7:PRINT" to activate selection";
55 1814  0244
```

```
  Offset  Data   Source Line
1814  0244  DISP.PARMS:
1819  0244          'display 18 menu choices in yellow
1819  0244
1819  0244          COLOR 14,0
1819  0244          FOR MENUI = 0 TO 17
1825  0244                GOSUB DISPMENU
1829  0244          NEXT MENUI
1831  0244
1841  0244          'set for reagent name and highlight it
1841  0244          MENUI = 6:COLOR 0,7
1841  0244          GOSUB DISPMENU
1854  0244
185A  0244          SCREEN 0,0,0,0
185A  0244          RETURN
186F  0244  REM $PAGE
1873  0244
```

```
Offset  Byte   Source Line

1873    0244   DISPMENU:
1878    0244           LOCATE (MENUX MOD 6)*2+7,(INT(MENUX/6)*20+2)*15+INT(MENUX/12)
1884    0244           PRINT MENUS(MENUX,0)
188F    0244           IF MENUX > 5 THEN GOTO SHOWSTRING:'     no value to display
1901    0244           LOCATE (MENUX MOD 6)*2+7,MENU(MENUX,4)
1933    0244           PRINT USING MENUS(MENUX,1);MENU(MENUX,0);
1964    0244           IF MENUX > 2 THEN RETURN
1975    0244           ON MENUX+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
1986    0244           RETURN
198A    0244   SHOWSTRING:
198F    0244           IF MENUX > 10 THEN RETURN
195E    0244           LOCATE (MENUX MOD 6)*2+7,48
1988    0244           PRINT "                "
19C7    0244           LOCATE (MENUX MOD 6)*2+7,48
19E3    0244           PRINT MENUS(MENUX,1)
1A02    0244           RETURN
1A06    0244
1A06    0244   SET.FREQ:
1A08    0244           TEMP = MENU(0,0)
1A24    0244           CALL SET.DOT.RATE(TEMP):        'in module PCI
1A34    0244           LED% = 3-INT((TEMP+500)/1000)
1A57    0246           IF LED% < 0 THEN LED% = 0
1A69    0246           SCR% = 4 + (LED% * 32):                 'set LED intensity
1A89    0246           CALL DIGITAL.OUT(SCR%):                 'in module PCI
1A99    0246           RETURN
1A9D    0246
1A9D    0244   SET.AMP:
1AA2    0246           SCR% = CINT(MENU(MENUX,0) * 255 / 150):         'convert volts to binary number
1ACB    0246           IF SCR% = OLD.AMP.VALUE% THEN RETURN
1ADC    0246           TEMP% = SCR% - OLD.AMP.VALUE%:          'calculate delta
1AEB    0248           OLD.AMP.VALUE% = SCR%:                  'update old value to current value
1AEF    0248           DIG.VAL% = 8
1AF6    024A           IF TEMP% < 0 THEN DIG.VAL% = 5
1B08    024A           TEMP% = ABS(TEMP%)
1B15    024A           FOR I% = 1 TO TEMP%
1B22    024C                   SCR% = DIG.VAL% + (32*LED%)
1B3F    024C                   CALL DIGITAL.OUT(SCR%):                 'pulse higher or lower
1B4F    024C                   SCR% = 4 + (32 * LED%)
1B6F    024C                   CALL DIGITAL.OUT(SCR%):                 'set port to normal
1B7F    024C           NEXT I%
1B91    024C           RETURN
1B95    024C
1B95    024C   SET.DELAY:
1B9A    024C           TEMP = MENU(2,0)
1BB6    024C           CALL SET.STROBE.DELAY(TEMP):    'in module PCI
1BC6    024C           RETURN
1BCA    024C
1BCA    024C   REM $PASS
```

```
Reagent Jet Printer
Reagent Calibration

 Offset  Data    Source Line

  1BCA   024C    '************ DATA USED BY THIS MODULE ************
  1BCA   024C
  1BCA   024C    ARRDATA:
  1BCF   024C            DATA "Frequency              Hz",",##,###",10000,1,1,16
  1BD1   024C            DATA "Amplitude              V ",",###",150,0,1,19
  1BD3   024C            DATA "Strobe Delay           uS",",##,###.#",15999.5,.5,.5,16
  1BD5   024C            DATA "Pulse Width              ",",###",999,0,1,19
  1BD7   024C            DATA "Rise Time                ",",###",999,0,1,19
  1BD9   024C            DATA "Fall Time                ",",###",999,0,1,19
  1BDB   024C            DATA "Mass","",0,0,0,0
  1BDD   024C            DATA "Concentration","",0,0,0,0
  1BDF   024C            DATA "Density","",0,0,0,0
  1BE1   024C            DATA "Viscosity","",0,0,0,0
  1BE3   024C            DATA "Surface Tension","",0,0,0,0
  1BE5   024C            DATA "","",0,0,0,0
  1BE7   024C            DATA "START","",0,0,0,0
  1BE9   024C            DATA "LOAD","",0,0,0,0
  1BEB   024C            DATA "SAVE","",0,0,0,0
  1BED   024C            DATA "EXIT","",0,0,0,0
  1BEF   024C            DATA "","",0,0,0,0
  1BF1   024C            DATA "","",0,0,0,0
  1BF3   024C
  1BF3   024C    TABLE:
  1BF8   024C            DATA 3,1,218
  1BFA   024C            DATA 3,28,210
  1BFC   024C            DATA 3,69,210
  1BFE   024C            DATA 3,80,191
  1C00   024C            DATA 5,1,198
  1C02   024C            DATA 5,28,206
  1C04   024C            DATA 5,69,206
  1C06   024C            DATA 5,80,181
  1C08   024C            DATA 19,1,192
  1C0A   024C            DATA 19,28,208
  1C0C   024C            DATA 19,69,208
  1C0E   024C            DATA 19,80,217
  1C10   024C
  1C10   024C    END SUB
  1C17   024C
  1C17   024C
  23EB-  024C

 50426 Bytes Available
 43360 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

```
Offset  Data    Source Line
0030    0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Entry/Modif
                ication'
0030    0006    '*MODULE   - "PATENT" Pattern creation, modification, and filing
0030    0006    '
0030    0006    '*AUTHOR   - M. A. Enevold
0030    0006    '
0030    0006    '*COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    '
0030    0006    '*REVISION - 1.2 03-10-86 MAE Remove Mouse inputs
0030    0006    '            1.1 02-20-86 MAE Add 80 pattern limit to save
0030    0006    '            1.0 01-13-86 MAE Creation of initial code
0030    0006    '
0030    0006    '*SYSTEM   - This code can only be compiled by the BASCOM
0030    0006    '            COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    '*DESCRIPTION:
0030    0006    '       This module allows the user to LOAD, SAVE, DIRectory, D
                RAW and
0030    0006    '       enter repeat count and other parameters for a pattern t
                o be printed.
0030    0006    '       The low-resolution graphics mode is selected and a menu
                 is displayed
0030    0006    '       across the bottom of the screen.  Using arrow keys
0030    0006    '       point to the action to be taken and then invoke that ac
                tion with the
0030    0006    '       Enter key.  In the DRAW mode, another menu is
0030    0006    '       displayed which allows the user to select from LINE, RE
                CTangle,
0030    0006    '       Solid RECTangle, or CIRCle pattern elements.
0030    0006    '
0030    0006    '*DATA DICTIONARY
0030    0006    '       SCNDAT%(50,5)     51 Row (Elements) by 6 Column array f
                or storing pattern elements
0030    0006    '       CURSOR%(9)        Storage for cursor graphics icon
0030    0006    '       MENU$(6)          Up to 7 menu names can be saved here
0030    0006    '       ELNUM%            Count of number of elements in a patt
                ern
0030    0006    '       X% Y%             Current location of graphics cursor
0030    0006    '       GRID              Value of one dot space on the screen
                (default is 0.005")
0030    0006    '       ROW% COL%         Location to print instructions
0030    0006    '       A$                Storage for single key-strokes or inp
                ut strings
0030    0006    '       MENUNUM           Which menu is being displayed (1 or 2
                )
0030    0006    '       ITEM              Pointer to which menu item is highlig
                hted (0 - 6)
0030    0006    '       REPEAT%           Number of times pattern is to be repe
                ated when printed
0030    0006    '       IOFF  YOFF        X and Y axis distance between the pri
                nting of repeated patterns
0030    0006    '       ROWSP COLSP       Row and Column spacing for printing m
                ultiple sets of patterns
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006    '       PATNUM%             -   Number of patterns stored in
the pattern directory PATDIR.RJP
 0030   0006    '       BROW% BCOL%     Row and Colown location to display di
rectory entrys
 0030   0006    '       NAME$           Pattern name to be LOADed or SAVEd to
 directory
 0030   0006    '       I% J%           Counters used to LOAD or SAVE the ele
ment data from/to pattern data file
 0030   0006    '       FILE$           Name of pattern data file
 0030   0006    '       TEMP%           Which type of element is being drawn.
  1 = Line   2 = Rectangle
 0030   0006    '
 3 = Solid Rectangle  4 = Circle
 0030   0006    '       FLAG%           Same as TEMP% above
 0030   0006    '       STARTMSG$ ENDMSG$ Message display for startpoint and en
dpoint of element entry
 0030   0006    '       X1% Y1%                 Starting cursor position for
element being drawn
 0030   0006    '       DI% DY%                 Delta I and Y values used to
re-position cursor after arrow key
 0030   0006    '       MAXITEM                 The highest number item in th
e current menu display
 0030   0006    '       IS  IE          Starting and ending I position of the
 menu highlighting blue box
 0030   0006    '       RADIUS%                 The calculated radius of a ci
rcle to be displayed
 0030   0006    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030  0006  SUB PATENTRY STATIC
0047  0006
0047  0006          WIDTH 40:SCREEN 1:CLS
005F  0006          DIM SCNDATZ(50,5),CURSORZ(9),MENU$(6)
0060  029A          ELNUMZ = 0:IZ=0:YZ=0:GRID = 0.005
007F  02A4
007F  02A4          LINE (0,0)-(6,6),,B
00A1  02A4          LINE (0,3)-(6,3),,B
00C5  02A4          LINE (3,0)-(3,6),,B
00E9  02A4          PRESET (3,3)
00F5  02A4          GET (0,0)-(6,6),CURSORZ
0116  02A4          CLS
011D  02A4
011D  02A4          LINE (0,0)-(319,190),,B
0140  02A4
0140  02A4          RESTORE INSTRUC
0147  02A4          FOR I=1 TO 4
0151  02A4                  READ ROWZ,COLZ,A$
0164  02AC                  LOCATE ROWZ,COLZ:PRINT A$;
01B0  02AC          NEXT I
019B  02B0
019B  02B0    FIRST:
01A0  02B0          MENUNUM = 1
01AA  02B4          GOSUB SUBMENU
01B0  02B4
01B0  02B4          ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
              EAT, PATEXIT
01CD  02B8          GOTO FIRST
01D0  02B8
01D0  02B8    REPEAT:
01D5  02B8          GOSUB ITEMBOXERASE:     'erase blue box around DIR
01DB  02B8          LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
01FB  02B8          LOCATE 25,1:INPUT;"Enter Repeat Count  ",REPEATZ
021B  02BA          LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0235  02BA          LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
0255  02BE          LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0272  02BE          LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
0292  02C2          GOTO FIRST
0296  02C2    PATEXIT:
029B  02C2          WIDTH 80:SCREEN 0:CLS
02B2  02C2          EXIT SUB
02B6  02C2    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 02B6   02C2    PATDIR:                    'list directory of patterns
 02BB   02C2            GOSUB ITEREDIERASE:     'erase blue box around DIR
 02C1   02C2            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 02DE   02C2            OPEN "PATDIR.RJP" FOR INPUT AS #1:      'open directory
                 file
 02EF   02C2            INPUT #1, PATNUM%:      'read number of patterns in dir
                ectory
 0301   02C4            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0326   02C4            I = 0:                          'set counter
 0330   02C4
 0330   02C4    DISLOOP:
 0335   02C4            I = I + 1:              'set for next value
 0344   02C4            IF I > PATNUM% THEN GOTO DIREXIT:       'test for done
 035B   02C4            IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
 0364   02C4            IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
 03A9   02C4
 03A9   02C4            LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
                ";
 03C3   02C4            GOSUB CORLOOP:  'wait for Y or N response
 03C9   02C4            IF A$ = "N" THEN GOTO DIREXIT:  'if N then don't contin
                ue
 03DC   02C4
 03DC   02C4            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0401   02C4
 0401   02C4    SHOWNEXT:
 0406   02C4            DROW% = ((I - 1) MOD 22) + 2:   'calculate row for disp
                lay
 0422   02C6            DCOL% = 4:                      'set column to 4
 0429   02C8            IF ((I - 1) MOD 44) > 21 THEN DCOL% = 23:'reset column
                if necessary
 044C   02C8
 044C   02C8            LINE INPUT #1, A$:      'read next name from directory
 0459   02C8            LOCATE DROW%,DCOL%:PRINT A$;    'PRINT NAME
 0475   02C8            GOTO DISLOOP
 0479   02C8
 0479   02C8    DIREXIT:
 047E   02C8            CLOSE #1:       'terminate access to PATDIR.RJP
 0485   02C8            GOTO FIRST
 0489   02C8
 0489   02C8    REM $PAGE
```

```
Offset  Byte    Source Line
 0489   02C3    PATLOAD:
 048E   02C8            GOSUB ITEM2D1ERASE:     'erase blue box around DIR
 0494   02C8            OPEN "PATDIR.RJP" FOR INPUT AS #1
 04A5   02C8            INPUT #1,PATNUM%:       'read number of patterns in dir
 04B7   02C8            GOSUB GETNAME:          'prompt for and input pattern n
ame
 04BD   02C8            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 04E2   02C8
 04E2   02C8            GOSUB SEARCH
 04E8   02C8
 04EB   02C8            IF I% < (PATNUM% + 1) THEN GOTO FOUND
 04FC   02C8            LOCATE 10,16-(LEN(NAME$)/2):PRINT NAME$;" not Found";
 0531   02CE            LOCATE 12,14:PRINT "Strike Any Key"
 054B   02CE            GOSUB ANYKEY:   'wait for a keyhit
 0551   02CE            GOTO FIRST
 0555   02CE
 0555   02CE    FOUND:
 055A   02CE            FILE$ = RIGHT$(STR$(I%),LEN(STR$(I%))-1) + "PAT.RJP"
 057E   02D2            OPEN FILE$ FOR INPUT AS #1:     'set pattern data file
for read
 058F   02D2            INPUT #1,ELNUM%:        'read number of elements in pat
tern
 05A1   02D2            INPUT #1,GRID:          'read grid size
 05B3   02D2            INPUT #1,REPEAT%:       'read repeat count
 05C5   02D2            INPUT #1,XOFF:          'read x axis offset for repeat
 05D7   02D2            INPUT #1,YOFF:          'read y axis offset for repeat
 05E9   02D2
 05E9   02D2            FOR I% = 0 TO ELNUM% - 1
 05F7   02D4                FOR J% = 0 TO 5
 05FD   02D4                    INPUT #1,SCREEN%(I%,J%):'read file into screen
array
 0621   02D6                NEXT J%
 0631   02D6            NEXT I%
 0643   02D6            CLOSE #1:       'done with data file
 064A   02D6
 064A   02D6            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 065C   02D6            PRINT #1,FILE$:                 'save filename in defau
lt file
 066C   02D6            PRINT #1,NAME$:                 'save the directory nam
e as well
 067C   02D6            CLOSE #1
 0683   02D6
 0683   02D6            GOTO REDRAW
 0687   02D6
 0687   02D6    SEARCH:
 068C   02D6            I% = 1:                         'set entry pointer
 0693   02D6    SLOOP:
 0698   02D6            LINE INPUT #1,A$:       'read next pattern name from di
r
 06A5   02D6            IF A$ = NAME$ THEN GOTO SEARCH.END:     'compare name w
ith dir entry
 06B8   02D6            I% = I% + 1
 06C1   02D6            IF I% < (PATNUM% + 1) THEN GOTO SLOOP:'check for done
 06D4   02D6    SEARCH.END:
```

```
Reagent Jet Printer                                          PAGE  6
Pattern Entry/Modification                                   07-05-86
                                                             10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 06D9   02DA            CLOSE #1:     'not found so close file and display me
                        ssage
 06E0   02F6            RETURN
 06E4   02DA
 06E4   02F6    REM $PAGE
```

```
Offset  Data    Source Line
 06E4   02D6    PATSAVE:
 06E9   02D6            GOSUB ITEMBOXERASE:     'erase blue box around DIR
 06EF   02D6            IF ELNUM% = 0 THEN GOTO FIRST:  'no elements in pattern
 06FE   02D6            OPEN "PATDIR.RJP" FOR INPUT AS #1
 070F   02D6            INPUT #1,PATNUM%
 0721   02D6            IF PATNUM% < 80 THEN GOTO SAVE.PAT:     'directory full
                 at 80 patterns
 0730   02D6            CLOSE #1
 0737   02D6            LOCATE 25,1:PRINT SPACE$(39);:          'erase bottom l
                ine
 0754   02D6            LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
                ;
 076E   02D6            GOSUB ANYKEY:GOTO FIRST
 0778   02D6    SAVE.PAT:
 077D   02D6            GOSUB GETNAME:  'prompt for and get pattern name
 0783   02D6            GOSUB SEARCH
 0789   02D6            IF I% > PATNUM% THEN GOTO ADD.NEW.PATTERN
 079A   02D6            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 07BF   02D6            LOCATE 10,13-(LEN(NAME$)/2):PRINT NAME$;" already exist
                s.";
 07F4   02D6            LOCATE 12,15:PRINT "Replace it?"
 080E   02D6            PATNUM% = I%
 0815   02D6            A$ = ""
 081F   02D6            WHILE A$ = ""
 082E   02D6                    A$ = INKEY$
 0838   02D6            WEND
 083B   02D6            IF A$ = "Y" OR A$ = "y" THEN GOTO SAVE.PATTERN
 0864   02D6            GOTO FIRST
 0868   02D6
 0868   02D6    ADD.NEW.PATTERN:
 086D   02D6            KILL "PATDIR.OLD":      'delete old backup directory
 0874   02D6            NAME "PATDIR.RJP" AS "PATDIR.OLD":      'save old direc
                tory
 087E   02D6            OPEN "PATDIR.OLD" FOR INPUT AS #1
 088F   02D6            OPEN "PATDIR.RJP" FOR OUTPUT AS #2:     'set up new dir
 08A1   02D6            INPUT #1,PATNUM%:       'read number of dir entries
 08B3   02D6            PATNUM% = PATNUM% + 1:  'increase by 1
 08BC   02D6            WRITE #2,PATNUM%:       'save in new directory
 08CD   02D6            FOR I=1 TO PATNUM% - 1
 08E6   02DA                LINE INPUT #1,A$:   'read entry from old dir
 08F3   02DA                PRINT #2,A$:        'write entry in new directory
 0903   02DA            NEXT I
 091E   02DA            PRINT #2,NAME$:         'write new entry to new directo
                ry
 092E   02DA            CLOSE #1:CLOSE #2:      'done with directory
 093C   02DA    SAVE.PATTERN:
 0941   02DA            FILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) + ".P
                AT.RJP"
 0965   02DA            OPEN FILE$ FOR OUTPUT AS #1:    'create new pattern dat
                a file
 0977   02DA            WRITE #1,ELNUM%:        'store number of elements
 0988   02DA            WRITE #1,GRID:          'store grid dimension
 0998   02DA            WRITE #1,REPEAT%:       'store repeat count
 09A9   02DA            WRITE #1,XOFF:          'store x axis offset for repeat
```

```
Offset  Data     Source Line
09B9    02DA          WRITE #1,YOFF:          'store y axis offset for repeat
09C9    02DA          FOR IZ = 0 TO ELEMENT - 1
09D7    02DC              FOR JZ = 0 TO 5
09DD    02EC                  WRITE #1,SCNDATZ(IZ,JZ):        'write screen a
                rray to file
0A09    02EC              NEXT JZ
0A10    02EC          NEXT IZ
0A22    02DC          CLOSE #1:       'done with data file
0A29    02DC          OPEN "PATDEF.RIP" FOR OUTPUT AS #1
0A3B    02DC          PRINT #1,FILE$:                 'save filename in defau
                lt file
0A4B    02DC          PRINT #1,NAME$:                 'save the directory nam
                e as well
0A5B    02DC          CLOSE #1
0A62    02DC          GOTO FIRST
0A66    02DC    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0A6e  02DC  PATCRAM:
0A63  02DC          GOSUB ITEMSCIERASE
0A71  02DC          LINE (1,1)-(318,189),0,BF:      'Erase graphics tablet
0A96  02DC
0A96  02DC  NEXTEL:
0A9E  02DC          MENUNUM = 2
0AA5  02DC          GOSUB SUBMENU
0AAB  02DC
0AAB  02DC          ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
                    ACKUP
0ACB  02DC          GOTO NEXTEL
0ACB  02DC
0ACB  02DC  BACKUP:
0AD0  02DC          GOSUB ITEMBOIERASE
0AD6  02DC          GOTO FIRST
0ADA  02DC
0ADA  02DC  ALINE:
0ADF  02DC          TEMP1 = 1
0AE6  02E6          STARTMSG$ = "STARTING ENDPOINT"
0AF0  02E2          ENDMSG$ = "ENDING ENDPOINT  "
0AFA  02E6          GOTO ENTERELEMENT
0AFE  02E6
0AFE  02E6  RECT:
0B03  02E6          TEMP1 = 2
0B0A  02E6          GOTO RECTMSG
0B0E  02E6
0B0E  02E6  SRECT:
0B13  02E6          TEMP1 = 3
0B1A  02E6  RECTMSG:
0B1F  02E6          STARTMSG$ = "STARTING CORNER"
0B29  02E6          ENDMSG$ = "ENDING CORNER  "
0B33  02E6          GOTO ENTERELEMENT
0B37  02E6
0B37  02E6  ACIRCLE:
0B3C  02E6          TEMP1 = 4
0B43  02E6          STARTMSG$ = "CENTER OF CIRCLE"
0B4D  02E6          ENDMSG$ = "POINT ON CIRCLE  "
0B57  02E6
0B57  02E6  ENTERELEMENT:
0B5C  02E6          GOSUB ITEMBOIERASE
0B62  02E6          FLAG=0
0B69  02EB          LOCATE 25,1:PRINT SPACE$(39);
0B86  02EB          LOCATE 25,1:PRINT STARTMSG$;
0BA0  02EB          GOSUB DISPCURSOR
0BA6  02EB  FINDSTART:
0BAB  02EB          GOSUB MOUSEACT
0BB1  02EB          IF A$ = CHR$(27) THEN GOTO ABORT
0BC8  02EB          IF A$ = CHR$(13) THEN GOTO SETSTART
0BCF  02EB          GOSUB CURSORMOVE
0BE5  02EB          GOTO FINDSTART
0BEB  02EB  ABORT:
0BED  02EB          GOSUB PLACECURSOR
0BF3  02EB          GOTO NEXTEL
0BF7  02EB
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
 0BF7  02EB    SETSTART:
 0BFC  02EB            LOCATE 25,1:PRINT ENDMSG$;
 0C16  02EB            FLAGZ = TEMPZ:IIZ = XZ:YIZ = YZ
 0C2B  02EC            IF FLAGZ = 4 THEN PSET (XZ+4,YZ+4)
 0C55  02EC    FINDEND:
 0C5A  02EC            GOSUB MOUSEACT
 0C60  02EC            IF A$ = CHR$(27) THEN GOTO CANCELEL
 0C77  02EC            IF A$ = CHR$(13) THEN GOTO SAVEEL
 0C8E  02EC            GOSUB CURSORMOVE
 0C94  02EC            GOTO FINDEND
 0C97  02EC    CANCELEL:
 0C9C  02EC            GOSUB PLACECURSOR
 0CA2  02EC            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0CB3  02EC            FLAGZ = 0
 0CBA  02EC            GOTO NEXTEL
 0CBE  02EC    SAVEEL:
 0CC3  02EC            GOSUB PLACECURSOR
 0CC9  02EC            IF FLAGZ = 4 THEN CIRCLE (IIZ+4,YIZ+4),SQR((XZ-IIZ)^2+(
                       YZ-YIZ)^2),,,,1
 0D32  02EC            GOSUB CORRECT
 0D3B  02EC            IF A$="N" THEN GOTO REDRAW
 0D4B  02EC    STOREEL:
 0D50  02EC            SCNDATZ(ELNUMZ,0) = FLAGZ
 0D6A  02EC            SCNDATZ(ELNUMZ,1) = IIZ
 0D85  02EC            SCNDATZ(ELNUMZ,2) = YIZ
 0DA0  02EC            SCNDATZ(ELNUMZ,3) = XZ
 0DBB  02EC            SCNDATZ(ELNUMZ,4) = YZ
 0DD6  02EC            SCNDATZ(ELNUMZ,5) = 0
 0DEF  02EC            ELNUMZ = ELNUMZ + 1
 0DF8  02EC            FLAGZ = 0
 0DFF  02EC            GOTO NEXTEL
 0E03  02EC    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0E03    02EC    REDRAW:
0E08    02EC            GOSUB ITEMBOXERASE
0E0E    02EC            LINE(1,1)-(318,189),0,BF
0E33    02EC            IF ELNUM% = 0 THEN GOTO NEXTEL
0E42    02EC
0E42    02EC            FOR I=0 TO ELNUM%-1
0E5B    02F0                    ON SCNDATI%(I,0) GOSUB RD1, RD2, RD3, RD4
0E81    02F0            NEXT I
0E9C    02F0            GOTO NEXTEL
0EA0    02F0
0EA0    02F0    '******** Sub-routines called by main module ********
0EA0    02F0
0EA0    02F0    SUBMENU:
0EA5    02F0
0EA5    02F0            LOCATE 25,1:PRINT SPACE$(39);
0EC2    02F0            ON MENUNUM GOSUB MENU1, MENU2
0ED1    02F0
0ED1    02F0            FOR I=0 TO 6
0EDB    02F0                    READ MENUS(I)
0EF2    02F0                    LOCATE 25,(I*6)+2:PRINT MENUS(I);
0F2B    02F0            NEXT I
0F46    02F0
0F46    02F0            READ MAXITEM
0F4D    02F4            ITEM = 0
0F57    02F4
0F57    02F4    NEWITEM:
0F5C    02F4            GOSUB NEWITEMBOX
0F62    02F4
0F62    02F4    NEXTITEM:
0F67    02F4            GOSUB ITEMSEARCH
0F6D    02F4            IF A$ = CHR$(13) THEN RETURN:'  ITEM has correct value
0F84    02F4            IF LEN(A$) < 2 THEN BEEP:GOTO NEXTITEM
0F9A    02F4            IF ASC(MID$(A$,2,1)) = 75 THEN GOTO LEFTAR
0FB6    02F4            IF ASC(MID$(A$,2,1)) = 77 THEN GOTO RIGHTAR
0FD2    02F4            BEEP:GOTO NEXTITEM
0FD9    02F4
0FD9    02F4    LEFTAR:
0FDE    02F4            IF ITEM = 0 THEN GOTO NEXTITEM
0FEE    02F4            GOSUB ITEMBOXERASE
0FF4    02F4            ITEM = ITEM - 1
1003    02F4            GOTO NEWITEM
1007    02F4
1007    02F4    RIGHTAR:
100C    02F4            IF ITEM = MAXITEM THEN GOTO NEXTITEM
101F    02F4            GOSUB ITEMBOXERASE
1025    02F4            ITEM = ITEM + 1
1034    02F4            GOTO NEWITEM
1038    02F4
1038    02F4    MENU1:
103D    02F4            RESTORE MN1
1044    02F4            RETURN
1048    02F4
1048    02F4    MENU2:
104D    02F4            RESTORE MN2
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
1054  02F4          RETURN
1058  02F4
1058  02F4    ITEMSEARCH:
105D  02F4          A$ = INKEY$:IF A$ <> "" THEN RETURN
107A  02F4          GOTO ITEMSEARCH
107D  02F4          RETURN
1081  02F4
1081  02F4    NEWITEMBOX:
1086  02F4          IS = (ITEM*48) + 7
109C  02FB          IE = (ITEM*48) + 8 + LEN(MENUS(ITEM))*8
10D9  02FC          LINE (IS,191)-(IE,199),1,B
1101  02FC          RETURN
1105  02FC
1105  02FC    ITEMBOXERASE:
110A  02FC          LINE (IS,191)-(IE,199),0,B
1131  02FC          RETURN
1135  02FC
1135  02FC    PLACECURSOR:
113A  02FC          PUT (XZ+1,YZ+1),CURSOR2
1157  02FC          RETURN
115B  02FC
115B  02FC    MOUSEACT:
1160  02FC          GOSUB ANYKEY
1166  02FC          DXZ = 0 : DYZ = 0
1174  0300          IF A$ = CHR$(0) + CHR$(72) THEN DYZ = -1:RETURN
119D  0300          IF A$ = CHR$(0) + CHR$(80) THEN DYZ =  1:RETURN
11C6  0300          IF A$ = CHR$(0) + CHR$(77) THEN DXZ =  1:RETURN
11EF  0300          IF A$ = CHR$(0) + CHR$(75) THEN DXZ = -1:RETURN
1218  0300          IF A$ = "8" THEN DYZ = -20:RETURN
1232  0300          IF A$ = "2" THEN DYZ =  20:RETURN
124C  0300          IF A$ = "4" THEN DXZ = -20:RETURN
1266  0300          IF A$ = "6" THEN DXZ =  20:RETURN
1280  0300          IF A$ = CHR$(27) THEN RETURN
1297  0300          IF A$ = CHR$(13) THEN RETURN
12AE  0300          GOTO MOUSEACT
12B2  0300
12B2  0300    CURSORMOVE:
12B7  0300          GOSUB PLACECURSOR
12BD  0300          ON FLAGZ GOSUB ER1, ER2, ER3, ER4
12CE  0300          XZ = XZ + DXZ : YZ = YZ + DYZ
12E6  0300          IF XZ < 0 THEN XZ = 0
12F8  0300          IF XZ > 311 THEN XZ = 311
130B  0300          IF YZ < 0 THEN YZ = 0
131D  0300          IF YZ > 182 THEN YZ = 182
1330  0300          ON FLAGZ GOSUB DR1, DR2, DR3, DR4
1341  0300          GOSUB DISPCURSOR
1347  0300          RETURN
134B  0300
134B  0300    CORRECT:
1350  0300          LOCATE 25,1:PRINT SPACE$(39);
136D  0300          LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
1387  0300    CORLOOP:
138C  0300          GOSUB ANYKEY
1392  0300          IF A$ = "y" OR A$ = "Y" THEN A$ = "Y":GOTO COREXIT
```

```
Offset  Data    Source Line
 13C5   0300            IF A$ = "n" OR A$ = "N" THEN A$ = "N":GOTO COREXIT
 13F8   0300            GOTO CORLOOP
 13FB   0300    COREXIT:
 1400   0300            LOCATE 25,1:PRINT SPACE$(39);
 141D   0300            RETURN
 1421   0300
 1421   0300    DISPCURSOR:
 1426   0300            GOSUB PLACECURSOR
 142C   0300            LOCATE 25,27:PRINT USING "+#.###";XZ * GRID;
 1456   0300            PRINT ",";
 1463   0300            PRINT USING "+#.###";YZ * GRID;
 1480   0300            RETURN
 1484   0300
 1484   0300
 1484   0300    RD1:
 1489   0300            LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
                        DATZ(I,4)+4)
 1522   0300            RETURN
 1526   0300
 1526   0300    RD2:
 152B   0300            LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
                        DATZ(I,4)+4),,B
 15C4   0300            RETURN
 15C8   0300
 15C8   0300    RD3:
 15CD   0300            LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
                        DATZ(I,4)+4),,BF
 1667   0300            RETURN
 166B   0300
 166B   0300    RD4:
 1670   0300            RADIUSZ = SQR((SCNDATZ(I,3)-SCNDATZ(I,1))^2 + (SCNDATZ(
                        I,4)-SCNDATZ(I,2))^2)
 16FF   0302            CIRCLE (SCNDATZ(I,1)+4,SCNDATZ(I,2)+4),RADIUSZ,,,,1
 175D   0302            RETURN
 1761   0302
 1761   0302    DR1:
 1766   0302            LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4)
 17AF   0302            RETURN
 17B3   0302
 17B3   0302    DR2:
 17B8   0302            LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),,B
 1801   0302            RETURN
 1805   0302
 1805   0302    DR3:
 180A   0302            LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),,BF
 1854   0302            RETURN
 1858   0302
 1858   0302    DR4:
 185D   0302            RETURN
 1861   0302
 1861   0302    ER1:
 1866   0302            LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),0
 18AF   0302            RETURN
 18B3   0302
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 1883   0302    ER2:
 1888   0302            LINE (X1%+4,Y1%+4)-(X2+4,Y2+4),0,B
 1901   0302            RETURN
 1905   0302
 1905   0302    ER3:
 190A   0302            LINE (X1%+4,Y1%+4)-(X2+4,Y2+4),0,BF
 1954   0302            RETURN
 1958   0302
 1959   0302    ER4:
 195D   0302            RETURN
 1961   0302
 1961   0302    ANYKEY:
 1966   0302            A$ = ""
 1970   0302            WHILE A$ = ""
 1977   0302                    A$ = INKEY$
 1989   0302            WEND
 198C   0302            RETURN
 1990   0302
 1990   0302    GETNAME:        'prompt for and get filename
 1995   0302            LOCATE 25,1:PRINT SPACE$(39);
 19B2   0302            LOCATE 25,38:PRINT "<<";:       'boundry chevron
 19CC   0302            LOCATE 25,1:PRINT "Enter Pattern Name    ";
 19E6   0302            LINE INPUT; "",NAME$
 19F4   0302            RETURN
 19FB   0302
 19FB   0302    ' Data fields used by this module
 19FB   0302
 19FB   0302    MN1:
 19FD   0302            DATA "DIR","LOAD","SAVE","GRAM","REPT","EXIT","",5
 19FF   0302
 19FF   0302    MN2:
 1A04   0302            DATA "LINE","RECT","FRECT","CIRCL","REDRW","MAIN","",5
 1A06   0302
 1A06   0302    INSTRUC:
 1A0B   0302            DATA 8,16,"USE ARROWS"
 1A0D   0302            DATA 10,9,"TO SELECT FROM THE MENU"
 1A0F   0302            DATA 14,12,"USE THE ENTER KEY"
 1A11   0302            DATA 16,10,"TO ACTIVATE SELECTION"
 1A13   0302
 1A13   0302    END SUB
 1A1A   0302
 21AF   0302

50426 Bytes Available
43373 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0000 0006 REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Burr-Brown PCI-2000
          0 custom driver'
0030 0006 'MODULE  - "PCI" Driver for the PCI-20000 I/O and PULSE cards
0030 0006 '
0030 0006 'AUTHOR  - M. S. Fairchild of Computing Architects Inc.
0030 0006 '                          113 Fairfield Way
0030 0006 '                          Bloomingdale, Il 60108
0030 0006 '                          312/980-6777
0030 0006 '
0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006 '
0030 0006 'REVISION - 1.2 12-16-85 MSF Add digital I/O initalization, and
           output routine
0030 0006 '
0030 0006 '        - 1.1 12-10-85 MSF Move counter module to position 2
0030 0006 '
0030 0006 '        - 1.0 11-22-85 MSF Creation of initial code
0030 0006 '
0030 0006 'SYSTEM  - This code can only be compiled by the BASCOM V2
0030 0006 '          COMPILER, it will not run under the INTERPRETER!!
0030 0006 '
0030 0006 'DESCRIPTION:
0030 0006 '             The PCI module is a group of routines used to a
          ccess
0030 0006 '       the BURR-Brown PCI-20000 board. The supplied software c
          auses
0030 0006 '       the Wordstar2000 software to malfunction and will not p
          rivide
0030 0006 '       explicit on, off functions for the counters.  Custom dr
          ivers
0030 0006 '       will be made to provide all of the desired functions.
0030 0006 '
0030 0006 '
0030 0006 '       Address        Register
0030 0006 '       &HC0000 Carrier I.D. / module present (R)
0030 0006 '       &HC0040 Module interrupt status (R)
0030 0006 '       &HC0080 Digital I/O port 0 (R/W)
0030 0006 '       &HC0081 Digital I/O port 1 (R/W)
0030 0006 '       &HC0082 Buffer direction and enable (R/W)
0030 0006 '       &HC0083 Control for ports 0 and 1 (W)
0030 0006 '       &HC00C0 Digital I/O port 2 (R/W)
0030 0006 '       &HC00C1 Digital I/O port 3 (R/W)
0030 0006 '       &HC00C3 Control for ports 2 and 3 (W)
0030 0006
0030 0006 '       &HC0200        Read module I.D. (1110 1010)
0030 0006 '       &HC0204        Rate generator low-order 16 bits (0)
0030 0006 '       &HC0205        Rate generator high-order 16 bits (1)
0030 0006 '       &HC0206        Counter 3 count register (2)
0030 0006 '       &HC0207        Rate generator/counter 3 control
0030 0006 '       &HC0208        Counter 0 count register (0)
0030 0006 '       &HC0209        Counter 1 count register (1)
0030 0006 '       &HC020A        Counter 2 count register (2)
0030 0006 '       &HC020B        Counter 0 - 2 control
0030 0006 '       &HC020C        Counter gate control (1 enables, 0 disa
```

```
                    bits;
0030  0006  '             bit     function
0030  0006  '             0       Rate generator gate
0030  0006  '             1       Rate generator gate
0030  0006  '             2       Counter 0 gate
0030  0006  '             3       Counter 1 gate
0030  0006  '             4       Counter 2 gate
0030  0006  '             5       Counter 3 gate
0030  0006  '             6       Not used
0030  0006  '             7       Not used
0030  0006  '
0030  0006  '
0030  0006  'DATA DICTIONARY
0030  0006  '
0030  0006  '       COUNT   - Divisor to 2Mhz rate to give desired frequenc
                  y or time
0030  0006  '       COUNTHZ         - High order 16 bits of a 32 bit diviso
                  r
0030  0006  '       COUNTLZ - Low order 16 bits of a 32 bit divisor
0030  0006  '       LSBZ    - Lower 8 bits of a 16 bit divisor
0030  0006  '       MSBZ    - Upper 8 bits of a 16 bit divisor
0030  0006
0030  0006  ' Main line code
0030  0006  '       The main line code is never executed. It's sole purpose
                   it to
0030  0006  ' declare shared the variables that will be used in the subrout
                  ines
0030  0006  ' so that they will all be defined and hold their values.
0030  0006
0030  0006  MAIN:_
0030  0006          DIM SHARED COUNT,COUNTHZ,COUNTLZ,LSBZ,MSBZ
0030  0006
0030  0006  MAINLOOP:_
0030  0006          GOTO MAINLOOP
004C  0012
004C  0012  REM $PAGE
```

```
Offset  Data    Source Line          ;;;; Personal Computer BASIC Compiler V2.00

004C    0012    'SUBROUTINE     - PCI.INIT
004C    0012    '
004C    0012    'DESCRIPTION:
004C    0012    '       The PCI.INIT subroutine initalizes the PCI hardware.
004C    0012
004C    0012    SUB PCI.INIT STATIC
0053    0012
0053    0012            DEF SEG = &HC000: 'Point segment to PCI-20000 board
005A    0012
005A    0012            POKE &H020C,&H00: 'Disable all software enabled counter
                s
0063    0012
0063    0012    ' Configure rate generator to 2 Mhz
0063    0012
0063    0012            POKE &H0207,&H34: 'Set low rate counter to mode 2
006D    0012            POKE &H0207,&H74: 'Set high rate counter to mode 2
0077    0012            POKE &H0204,&H02: 'Load low rate counter with 16 bits o
                f 2
0081    0012            POKE &H0204,&H00
008A    0012            POKE &H0205,&H02: 'Load high rate counter with 16 bits
                of 2
0094    0012            POKE &H0205,&H00
009D    0012            POKE &H020C,&H03: 'Enable rate counters
00A7    0012
00A7    0012    ' Configure dot rate counters (default to 5 Khz)
00A7    0012
00A7    0012            POKE &H0209,&H34: 'Set low dot counter (0) to mode 2
00B1    0012            POKE &H0208,&H74: 'Set high dot counter (1) to mode 2
00BB    0012            POKE &H0208,&H04: 'Load low rate counter with 16 bits o
                f 4
00C5    0012            POKE &H0208,&H00
00CE    0012            POKE &H0209,&H64: 'Load high rate counter with 16 bits
                of 100
00D8    0012            POKE &H0209,&H00
00E1    0012
00E1    0012    ' Configure dot pulse with one shot (default to 13 usec)
00E1    0012
00E1    0012            POKE &H0203,&H02: 'Set dot pulse with oneshot (2) to mo
                de 1
00EB    0012            POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
00F5    0012            POKE &H020A,&H00
00FE    0012
00FE    0012    ' Configure shifted strobe pulse one shot (default to .5 usec)
00FE    0012
00FE    0012            POKE &H0207,&HB2: 'Set shifted strobe onshot (3) to mod
                e 1
0108    0012            POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
0112    0012            POKE &H0206,&H00
011B    0012
011B    0012    ' Configure port 0 to output and port 1 to input
011B    0012
011B    0012            POKE &H0083,&H82: ' Set up I/O chip
0125    0012            POKE &H0082,&H34: ' Set up direction and enable buffers
012F    0012            POKE &H0080,&H00: ' Dissable print head
```

```
Offset  Data    Source Line

 013B   0012          END SUB
 013F   0012
 013F   0012    REM $PASSIF:12
 013F   0012    'SUBROUTINE     - DOT.ON
 013F   0012    '
 013F   0012    'DESCRIPTION:
 013F   0012    '       The DOT.ON subroutine enables the dot frequency counter
                s.
 013F   0012
 013F   0012    SUB DOT.ON STATIC
 0146   0012
 0146   0012          POKE &H020C,&H0F: 'Enable dot counters and rate generat
                or
 0150   0012
 0150   0012          END SUB
 0157   0012
 0157   0012    REM $PASSIF:12
 0157   0012    'SUBROUTINE     - DOT.OFF
 0157   0012    '
 0157   0012    'DESCRIPTION:
 0157   0012    '       The DOT.OFF subroutine disables the dot counters
 0157   0012
 0157   0012    SUB DOT.OFF STATIC
 015E   0012
 015E   0012          POKE &H020C,&H03: 'Disable dot counters and enable rate
                 generator
 0168   0012
 0168   0012          END SUB
 016F   0012
 016F   0012    REM $PASSIF:49
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 016F   0012    'SUBROUTINE     - SET.DOT.RATE
 016F   0012    '
 016F   0012    'DESCRIPTION:
 016F   0012    '       The SET.DOT.RATE subroutine loads the dot rate counters
 016F   0012    ' with the desired dot frequency. Allowed range is 10,000 to 1
                Hz.
 016F   0012    ' The FREQ parameter is a real number in Hz.
 016F   0012
 016F   0012    SUB SET.DOT.RATE(FREQ) STATIC
 0176   0012
 0176   0012    ' Limit freqency to in range
 0176   0012
 0176   0012            IF FREQ < 1 THEN FREQ = 1
 018F   0012            IF FREQ > 10000 THEN FREQ = 10000
 01AB   0012
 01AB   0012    ' Convert to count and check for 16 bit count or 32 bit count
 01AB   0012
 01AB   0012            COUNT = 2E6 / FREQ
 01B8   0012            IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
 01CF   0012
 01CF   0012    ' Process count of 32 bits
 01CF   0012
 01CF   0012    DIVIDE32:
 01D0   0012            COUNTLI = INT((COUNT/32768!) + 1): 'Stage lower count
 01F0   0012            COUNTHI = INT(COUNT/COUNTLI): 'Form upper count
 020B   0012            GOTO SET.COUNT
 020F   0012
 020F   0012    ' Process count of 16 bits
 020F   0012
 020F   0012    DIVIDE16:
 0214   0012            COUNTLI = 2
 021B   0012            COUNTHI = INT(COUNT/2)
 0232   0012            GOTO SET.COUNT
 0236   0012
 0236   0012    ' Send the derived counts out to the counters
 0236   0012
 0236   0012    SET.COUNT:
 0237   0012            LSBI = COUNTLI MOD 256: ' Send out low 16 bits
 0248   0012            MSBI = INT(COUNTLI / 256)
 0263   0012            POKE &H0208,LSBI
 0273   0012            POKE &H0208,MSBI
 0283   0012
 0283   0012            LSBI = COUNTHI MOD 256: 'Send out high 16 bits
 0291   0012            MSBI = INT(COUNTHI / 256)
 02AC   0012            POKE &H0209,LSBI
 02BC   0012            POKE &H0209,MSBI
 02CC   0012
 02CC   0012            END SUB
 02D3   0012
 02D3   0012    REM $PAGEIF:27
```

```
02D3  0012  'SUBROUTINE     - SET.DOT.WIDTH
02D3  0012  '
02D3  0012  'DESCRIPTION:
02D3  0012  '       The SET.DOT.WIDTH subroutine loads the dot width one sh
ot
02D3  0012  ' with the desired dot pulse width. Allowed range is .5 to 16,0
00 usec.
02D3  0012  ' The dwidth parameter is a real number in usec.
02D3  0012
02D3  0012  SUB SET.DOT.WIDTH(DWIDTH) STATIC
02DA  0012
02DA  0012  ' Limit width to in range
02DA  0012
02DA  0012          IF DWIDTH < .5 THEN DWIDTH = .5
02F3  0012          IF DWIDTH > 16000 THEN DWIDTH = 16000
030C  0012
030C  0012  ' Convert to count
030C  0012
030C  0012          COUNT = DWIDTH / .5
031A  0012
031A  0012  ' Send the derived count out to the counter
031A  0012
031A  0012          LSBI = INT(COUNT MOD 256): ' Send out 16 bits
0331  0012          MSBI = INT(COUNT / 256)
0348  0012          POKE &H020A,LSBI
035B  0012          POKE &H020A,MSBI
036B  0012
0368  0012          END SUB
036F  0012
036F  0012  REM $PAGEIF:27
```

```
Offset  Data    Source Line
 036F   0012    'SUBROUTINE     - SET.STROBE.DELAY
 036F   0012    '
 036F   0012    'DESCRIPTION:
 036F   0012    '       The SET.STROBE.DELAY subroutine loads the strobe delay
                one shot
 036F   0012    ' with the desired strobe delay time. Allowed range is .5 to 16
                ,000 usec.
 036F   0012    ' The delay parameter is a real number in usec.
 036F   0012
 036F   0012    SUB SET.STROBE.DELAY(DELAY) STATIC
 0376   0012
 0376   0012    ' Limit delay to in range
 0376   0012
 0376   0012            IF DELAY < .5 THEN DELAY = .5
 036F   0012            IF DELAY > 16000 THEN DELAY = 16000
 03AB   0012
 03AB   0012    ' Convert to count
 03AB   0012
 03AB   0012            COUNT = DELAY / .5
 03B6   0012
 03B6   0012    ' Send the derived count out to the counter
 03B6   0012
 03B6   0012            LSB% = INT(COUNT MOD 256): ' Send out 16 bits
 03CD   0012            MSB% = INT(COUNT / 256)
 03E4   0012            POKE &H0206,LSB%
 03F4   0012            POKE &H0206,MSB%
 0404   0012
 0404   0012            END SUB
 040B   0012
 040B   0012    REM $PAGEIF:16
 040B   0012    'SUBROUTINE     - DIGITAL.OUT
 040B   0012    '
 040B   0012    'DESCRIPTION:
 040B   0012    '       The DIGITAL.OUT subroutine sends the passed integer to
                the output
 040B   0012    '        port 0.
 040B   0012
 040B   0012    SUB DIGITAL.OUT(BYTE%) STATIC
 0412   0012
 0412   0012    ' Send the byte to the port
 0412   0012
 0412   0012            POKE &H0080,BYTE%
 0423   0012
 0423   0012            END SUB
 042A   0012
 057F   0012

50426 Bytes Available
48723 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data   Source Line

0030    0006  REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Printing' $LINESIZE:132
0030    0006  '$MODULE  - 'PATTERN'
0030    0006  '
0030    0006  '$AUTHOR  - M. A. Emrold
0030    0006  '
0030    0006  '$COPYRIGHT (C) 1985 ARIOTT LABORATORIES
0030    0006  '
0030    0006  'REVISION - 2.0 07-02-86 MAE Modified for Microfab Printhead
0030    0006  '          - 1.1 03-07-86 MAE Added notes and final touches
0030    0006  '            1.0 02-03-86 MAE Creation of initial code
0030    0006  '
0030    0006  'SYSTEM  - This code can only be compiled by the BASCOM
0030    0006  '          COMPILER, it will not run under the INTERPRETER!!
0030    0006  '
0030    0006  'DESCRIPTION:
0030    0006  '     The printing module displays a menu in 3 columns of 4 rows each.  The first
0030    0006  '     column has data from the default reagent profile.  The second column has
0030    0006  '     data from the default pattern file.  The third column has standard printing
0030    0006  '     data.  The four arrow keys allow different menu items to be highlighted and
0030    0006  '     the values can be changed with the + or - keys or by entering the new number
0030    0006  '     followed by Enter.  P will cause the pattern to be printed, S will select the
0030    0006  '     notepad, and E will exit to the main program.  On the notepad, any single line
0030    0006  '     entered here will be sent to the printer.  A null line exits the notepad.
0030    0006  '
0030    0006  'DATA DICTIONARY
0030    0006  '     MENUI          Which menu item is highlighted (0-17)
0030    0006  '     DIFFI          Where to move menu highlight in response to arrow key
0030    0006  '     TYPEI          What key has been pressed during main scan
0030    0006  '     ELEMENTI       Number of elements in current pattern
0030    0006  '     SELPATI(50,3)  Array for storing elements in current pattern
0030    0006  '     REPEATI        Counter for repeat printing the pattern
0030    0006  '     CTI            Counter for stepping through the pattern array during printing
0030    0006  '     RADIUSI        Radius of circle during printing
0030    0006  '     XI YI          Offsets for start row/column position
0030    0006  '     REPXI REPYI    Repeat distances for repeat printing of patterns
0030    0006  '     SXI SYI        Starting X and Y positions for solid rectangles
0030    0006  '     EXI EYI        Ending X and Y positions for solid rectangles
0030    0006  '     II JI          Counters used for reading pattern files into the array
0030    0006  '     TEMPI          Register for misc. integers
0030    0006  '     NOTELINEI      Pointer to which line is active in the notepad
0030    0006  '     MENUS(17,1)    Array of strings used to display menu items
0030    0006  '     AS             Single keystroke input destination
0030    0006  '     NOTES          String entered in notepad and sent to printer
0030    0006  '     KEYBUFS        String entered from main scan and assigned to number of string field
0030    0006  '     REAGENTS       Name of default reagent
0030    0006  '     PATTERNS       Name of default pattern
0030    0006  '     FILES          Name of reagent data file and them pattern data file
0030    0006  '     MENU(11,4)     Array of values used in displaying menu item numbers
0030    0006  '     TEMP           Register for the temporary storage of real numbers
0030    0006  REM SPACE
```

```
Offset  Data   Source Line

0038    0064   SUB PATPRINT STATIC
0047    0064
0047    0064           DIM SCRDAT%(20,5),MENU%(17,1),MENU(17,4)
0048    0462
0048    0462           GOSUB INITIALIZE:       'read init. values and set screen
004E    0462
004E    0462           WHILE TYPE% () 1
0059    0464
0059    0464             TYPE% = 0
0060    0464             A$ = ""
006A    0468
006A    0468             WHILE A$ = ""
0079    0468               A$ = INKEY$
0083    0468             WEND
0086    0468
0086    0468             IF A$ = "E" OR A$ = "e" THEN TYPE% = 1:       'exit sub
0092    0468             IF A$ = "P" OR A$ = "p" THEN TYPE% = 2:       'print pattern
00DE    0468             IF A$ = "+" THEN TYPE% = 3:                   'increment variable
00F4    0468             IF A$ = "-" THEN TYPE% = 4:                   'decrement variable
010A    0468             IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 5:    'up arrow key
012F    0468             IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 6:    'down arrow key
0154    0468             IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 7:    'left arrow key
0179    0468             IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 8:    'right arrow key
019E    0468             IF A$ ) CHR$(47) AND A$ ( CHR$(58) THEN TYPE% = 9:' number 0-9
01D6    0468             IF A$ = "S" OR A$ = "s" THEN TYPE% = 10:      'enter scratchpad
0202    0468
0202    0468             ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
021F    0468
021F    0468           WEND
0223    0468           TYPE% = 0
022A    0468
022A    0468           EXIT SUB
022E    0468
022E    0468   '************ SUBROUTINES FOR THIS MODULE ************
022E    0468   T10:    'scratch pad
0233    0468           SCREEN 0,0,2,2:COLOR 7,0
0256    0468           LOCATE NOTELINE%,1
0264    046A   NOTELOOP:
0269    046A           LINE INPUT NOTE$
0277    046E           IF NOTE$ = "" THEN SCREEN 0,0,0,0:RETURN
029F    046E           LPRINT NOTE$
02AC    046E           IF NOTELINE% < 24 THEN NOTELINE% = NOTELINE% + 1
02C0    046E           GOTO NOTELOOP
02C3    046E
02C3    046E
02C3    046E   T1:
02C8    046E           RETURN:                 'exit to print menu, no action
02CC    046E
02CC    046E   T3:             'process "+" key
02D1    046E           IF MENU(MENUT,0) >= MENU(MENUT,1) THEN MENU(MENUT,0) = MENU(MENUT,1):RETURN:    'check max value
0330    0470           MENU(MENUT,0) = MENU(MENUT,0) + MENU(MENUT,3): 'add increment
0372    0470           COLOR 0,7:GOSUB DISPMENU:RETURN:                'show new value
0388    0470
0388    0470   T4:             'process "-" key
```

```
0000  0470          IF MENU(MENUZ,0) (= MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN:    'check min value
0012  0470          MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3): 'sub increment
0028  0470          COLOR 0,7:GOSUB DISPMENU:RETURN:                'show new value
0044  0470
0044  0470    T5:         'process up arrow key
0049  0470          IF MENUZ MOD 6 = 0 THEN RETURN:              'in top row already
005E  0470          DIFFZ = -1:GOSUB NEWMENU:RETURN:        'move pointer up one
006F  0472
0070  0472    T6:         'process down arrow key
0074  0472          IF MENUZ MOD 6 = 5 THEN RETURN:              'in bottom row already
0088  0472          DIFFZ = 1:GOSUB NEWMENU:RETURN:              'move pointer down one
0098  0472
0098  0472    T7:         'process left arrow key
00A0  0472          IF INT(MENUZ / 6) = 0 THEN RETURN       'in left column already
00C0  0472          DIFFZ = -6:GOSUB NEWMENU:RETURN:        'move pointer one left
00D1  0472
00D1  0472    T8:         'process right arrow key
00D6  0472          IF INT(MENUZ / 6) = 2 THEN RETURN       'in right column already
00F9  0472          DIFFZ = 6:GOSUB NEWMENU:RETURN:              'move pointer one right
010A  0472
010A  0472    T9:         'input keys into KEYBUFS until (cr) is entered
010F  0472          LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0141  0472          KEYBUFS = AS
0148  0476          WHILE AS () CHRS(13)
015E  0476                LOCATE 25,47:PRINT SPACES(20);
0178  0476                LOCATE 25,47:PRINT KEYBUFS;
0195  0476                AS = ""
019F  0476                WHILE AS = ""
01AE  0476                      AS = INKEYS
01BB  0476                WEND
01BB  0476                IF AS = CHRS(8) AND LEN(KEYBUFS) > 0 THEN KEYBUFS = LEFTS(KEYBUFS,LEN(KEYBUFS)-1)
01F8  0476                IF AS > CHRS(31) THEN KEYBUFS = KEYBUFS + AS
021E  0476          WEND
0222  0476          TEMP = VAL(KEYBUFS)      'temp has value of keys input
0232  047A
0232  047A          'round off temp according to step size in menu array
0232  047A          TEMP = INT(TEMP / (MENU(MENUZ,3)) + .5) * MENU(MENUZ,3)
0248  047A
0248  047A          'test TEMP for maximum and minimum values in menu array
0248  047A          IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
0266  047A          IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
027F  047A
027F  047A          'insert new value into menu array and update screen
027F  047A          MENU(MENUZ,0) = TEMP
0295  047A          LOCATE 25,30:PRINT SPACES(40);
02C5  047A          COLOR 0,7:GOSUB DISPMENU
02D4  047A          RETURN
02E8  047A
02E8  047A    T2:   'set Burr-Brown board then print desired pattern
02ED  047A
02ED  047A          BEEP:COLOR 15,0:LOCATE 25,1
02FA  047A          PRINT "Set Potentiometers on Printer....then Press any Key";
0327  047A          AS = ""
0331  047A          WHILE AS = ""
```

```
Offset  Data    Source Line

 0780   047A                AS = INKEY$
 078A   047A          WEND
 0780   047A          LOCATE 25,1:PRINT SPACE$(79);
 07AA   047A
 07AA   047A          'enter dros parameters into Burr-Brown board
 07AA   047A          TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
 07B3   047A          TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
 07ED   047A          TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
 0819   047A          CALL DOT.ON
 0825   047A
 0825   047A          TEMP% = 4
 0[illegible]   047C          CALL DIGITAL.OUT(TEMP%)
 083C   047C          TEMP% = 0:                  'pulse RESET line
 0843   047C          CALL DIGITAL.OUT(TEMP%)
 0253   047C          TEMP% = 4
 085A   047C          CALL DIGITAL.OUT(TEMP%)
 086A   047C
 086A   047C          JX = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal JX number of times
 0893   047E          FOR IX = 1 TO JX
 08A0   0480                TEMP% = 6:            'set HIGHER true
 08A7   0480                CALL DIGITAL.OUT(TEMP%)
 08B7   0480                TEMP% = 4:            'set HIGHER false
 08BE   0480                CALL DIGITAL.OUT(TEMP%)
 08CE   0480          NEXT IX
 08E0   0482
 08E0   0482          'establish COM1: and initialize plotter
 08E0   0482          OPEN "COM1:2400,N,8,2,CS 65535" AS #1
 08F2   0482          PRINT #1,";:DEC5,E7V1,A";
 0902   0482
 0902   0482          'move nozzle offset and establish new origin
 0902   0482          PRINT #1,"AO";
 0912   0482
 0912   0482          'calculate row/column location, move there, and set new origin
 0912   0482          XI = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
 0954   0484          YI = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
 0996   0486          PRINT #1,XI;YI;"O";
 0984   0486
 0984   0486          'print the pattern using repeat count
 0984   0486          REPYI = MENU(8,0) / 0.005
 0987   0488          REPXI = MENU(9,0) / 0.005
 09FA   048A
 09FA   048A          FOR REPEATI = 0 TO MENU(7,0)
 0A1C   048C
 0A1C   048C                'print the pattern
 0A1C   048C                FOR CTI = 0 TO ELMNT% - 1
 0A2A   0490                      ON SCHDAT%(CT%,0) GOSUB PLINE, PREET, PSREET, PCIRCL
 0A4C   0492                NEXT CTI
 0A5E   0492
 0A5E   0492                PRINT #1,"A,0,0,";:     'return to origin
 0A6E   0492                PRINT #1,REPXI;REPYI;"O";: 'move to next pattern
 0A3C   0492          NEXT REPEATI
 0AA1   0494
 0AA1   0494          PRINT #1,"H";:  'return plotter to original HOME
 0AB1   0494
```

```
5   Request Jet Printer
    Pattern Printing

    Offset  Data    Source Line

    0A81    0494            CLOSE #1:       'disable com1:
10  0A88    0494
    0A88    0494            RETURN
    0A8C    0494
    0A8C    0494    PLINE:
    0AC1    0494            PRINT #1,SCRDAT%(CT%,2);SCRDAT%(CT%,1);"D";
    0B03    0494            PRINT #1,SCRDAT%(CT%,4);SCRDAT%(CT%,3);"U";
15  0B45    0494            RETURN
    0B49    0494
    0B49    0494    PRECT:
    0B4E    0494            PRINT #1,SCRDAT%(CT%,2);SCRDAT%(CT%,1);"D";
    0B90    0494            PRINT #1,SCRDAT%(CT%,4);SCRDAT%(CT%,1);
    0BCC    0494            PRINT #1,SCRDAT%(CT%,4);SCRDAT%(CT%,3);
20  0C08    0494            PRINT #1,SCRDAT%(CT%,2);SCRDAT%(CT%,3);
    0C44    0494            PRINT #1,SCRDAT%(CT%,2);SCRDAT%(CT%,1);"U";
    0C86    0494            RETURN
    0C8A    0494
    0C8A    0494    PCIRCL:
    0C8F    0494            RADIUS% = SQR((SCRDAT%(CT%,3)-SCRDAT%(CT%,1))^2 + (SCRDAT%(CT%,4)-SCRDAT%(CT%,2))^2)
25  0D1A    0496            PRINT #1,"BC ";SCRDAT%(CT%,2);SCRDAT%(CT%,1);RADIUS%;
    0D63    0496            RETURN
    0D67    0496
    0D67    0496    PSRECT:
    0D6C    0496            SX% = SCRDAT%(CT%,4):EX% = SCRDAT%(CT%,2)
    0DA0    049A            SY% = SCRDAT%(CT%,3):EY% = SCRDAT%(CT%,1)
30  0DD4    049E            IF EX% <= SX% THEN SX% = SCRDAT%(CT%,2):EX% = SCRDAT%(CT%,4)
    0E15    049E            IF EY% <= SY% THEN SY% = SCRDAT%(CT%,1):EY% = SCRDAT%(CT%,3)
    0E56    049E
    0E56    049E            PRINT #1,SX%;SY%;"D";
    0E74    049E
    0E74    049E            IF EX% - SX% >= EY% - SY% THEN GOSUB STEPY ELSE GOSUB STEPX
35  0E9D    049E
    0E9D    049E            PRINT #1,"U";
    0EAD    049E            RETURN
    0EB1    049E
    0EB1    049E    STEPX:
    0EB6    049E            PRINT #1,EX%;SY%;
40  0ECE    049E            SY% = SY% + 1
    0ED7    049E            IF SY% > EY% THEN RETURN
    0EEB    049E            PRINT #1,EX%;SY%;SX%;SY%;
    0F0E    049E            SY% = SY% + 1
    0F17    049E            IF SY% > EY% THEN RETURN
45  0F28    049E            PRINT #1,SX%;SY%;
    0F40    049E            GOTO STEPY
    0F44    049E
    0F44    049E    STEPX:
    0F49    049E            PRINT #1,SX%;EY%;
    0F61    049E            SX% = SX% + 1
50  0F6A    049E            IF SX% > EX% THEN RETURN
    0F78    049E            PRINT #1,SX%;EY%;SX%;SY%;
    0FA1    049E            SX% = SX% + 1
    0FAA    049E            IF SX% > EX% THEN RETURN
    0FB8    049E            PRINT #1,SX%;SY%;
    0FD3    049E            GOTO STEPX
55
```

```
Offset  Data   Source Line

 0FD7   049E
 0FD7   049E   MENUSEL: 'write old item in yellow, point to and highlight new item
 0FDC   049E           COLOR 14,0:GOSUB DISPMENU
 0FEE   049E           MENUI = MENUI + DIFFI
 0FFA   049E           IF MENUI = 10 THEN MENUI = 9
 100C   049E           IF MENUI = 11 THEN MENUI = 9
 101E   049E           IF MENUI > 15 THEN MENUI = 15
 1030   049E           COLOR 0,7:GOSUB DISPMENU:RETURN
 1046   049E
 1046   049E   INITIALIZE:
 1048   049E           'change to screen 0 and display messages
 1048   049E           SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
 108F   049E           LOCATE 12,33:PRINT "Please Wait..."
 1089   049E
 10A9   049E           'initialize notepad on screen 2
 10A9   049E           SCREEN 0,0,2,1:CLS:COLOR 15
 10CE   049E           PRINT"Digital Notepad - - -All information typed here is sent to the printer"
 10DB   049E           NOTELINEI = 3
 10E2   049E
 10E2   049E           'initialize menu arrays
 10E2   049E           RESTORE ARRDATA
 10E9   049E           FOR II=0 TO 17
 10EF   049E                   READ MENUS(II,0),MENUS(II,1)
 111F   049E                   READ MENU(II,1),MENU(II,2),MENU(II,3),MENU(II,4)
 1180   049E           NEXT II
 1193   049E
 1193   049E           'get default reagent file and read values
 1193   049E
 1193   049E           OPEN "REAGEF.RJP" FOR INPUT AS #1
 11A4   049E           INPUT #1,FILE$
 11B6   04A2           INPUT #1,REANAME$
 11C8   04A6           CLOSE #1
 11CF   04A6
 11CF   04A6           OPEN FILE$ FOR INPUT AS #1:     'get reagent data
 11E0   04A6           INPUT #1,MENU(0,0):             'frequency
 1200   04A6           INPUT #1,MENU(1,0):             'amplitude
 1223   04A6           INPUT #1,MENU(2,0):             'strobe delay
 1246   04A6           INPUT #1,MENU(3,0):             'pulse width
 1269   04A6           INPUT #1,MENU(4,0):             'rise time
 128C   04A6           INPUT #1,MENU(5,0):             'fall time
 1281   04A6           CLOSE #1
 1288   04A6
 1288   04A6           'get default pattern file and read values
 1288   04A6
 1288   04A6           OPEN "PATDEF.RJP" FOR INPUT AS #1
 12C9   04A6           INPUT #1,FILE$
 12D8   04A6           INPUT #1,PATNAME$
 12ED   04AA           CLOSE #1
 12F4   04AA
 12F4   04AA           OPEN FILE$ FOR INPUT AS #1:     'get pattern data
 1305   04AA           INPUT #1,ELEMENTS
 1317   04AA           INPUT #1,MENU(6,0):             'grid
 132A   04AA           INPUT #1,MENU(7,0):             'repeat count
 133D   04AA           INPUT #1,MENU(8,0):             'x offset
```

```
Offset  Data    Source Line

 1280   04AA            INPUT #1,MENU(9,0);             'y offset
 1283   04AA            FOR II = 0 TO CLNUMX-1
 1291   04AC                    FOR JI = 0 TO 5
 1297   04AC                            INPUT #1,SCRDATI(II,JI)
 1308   04AC                    NEXT JI
 1313   04AC            NEXT II
 13F9   04AC            CLOSE #1
 1404   04AC
 1404   04AC            'set remaining parameters in menu array
 1404   04AC
 1404   04AC            MENU(12,0) = 1:                 'row 1
 1420   04AC            MENU(13,0) = 1:                 'column 1
 143C   04AC            MENU(14,0) = 0:                 'row spacing
 1458   04AC            MENU(15,0) = 0:                 'column spacing
 1474   04AC
 1474   04AC            'change active displayed screen to screen 0 to draw and display parameters
 1474   04AC
 1474   04AC            SCREEN 0,0,0,1:CLS
 1491   04AC
 1491   04AC            COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
 1482   04AC            COLOR 9
 1489   04AC            FOR I=2 TO 79
 14C3   04AC                    LOCATE 3,I:PRINT CHR$(196);:LOCATE 5,I:PRINT CHR$(205);:LOCATE 18,I:PRINT CHR$(196);
 1523   0480            NEXT I
 153E   0480            FOR I=4 TO 17
 1548   0480                    LOCATE I,1:PRINT CHR$(179);:LOCATE I,28:PRINT CHR$(186);:LOCATE I,54:PRINT CHR$(186);:LOCATE I,5
RINT CHR$(179);
 15C8   0480            NEXT I
 15E6   0480            RESTORE TABLE
 15ED   0480            FOR I=1 TO 12
 15F7   0480                    READ R1,C1,X1:LOCATE R1,C1:PRINT CHR$(X1);
 162A   0486            NEXT I
 1645   0486
 1645   0486            'display 16 menu choices in yellow
 1645   0486
 1645   0486            COLOR 14,0
 1651   0486            FOR MENUI = 0 TO 15
 1657   0486                    GOSUB DISPMENU
 1658   0486            NEXT MENUI
 1669   0486
 1669   0486            'set for first menu entry and highlight it
 1669   0486            MENUI = 0:COLOR 0,7
 1680   0486            GOSUB DISPMENU
 1686   0486
 1686   0486            'print three headings and instructions
 1686   0486            COLOR 10,0
 1692   0486            LOCATE 4,14.5-LEN(REANAME$)/2:PRINT REANAME$;
 16C1   0486            LOCATE 4,41-LEN(PATNAME$)/2:PRINT PATNAME$;
 16F0   0486            LOCATE 4,60:PRINT "PRINT LOCATION";
 170A   0486
 170A   0486            COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
 1754   0486            PRINT CHR$(32):CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
 1793   0486            LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
 17E9   0486            COLOR 7:PRINT" to scroll current value up or down";
```

Reagent Jet Printer
Pattern Printing


```
Offset  Data    Source Line

17FD    0486            LOCATE 21,3:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
183F    0486            COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
1867    0486            PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
189C    0486
189C    0486            'set screen to view menu just created and exit
189C    0486
189C    0486            SCREEN 0,0,0,0
1881    0486            RETURN
1885    0486
1685    0486    DISPMENU:
188A    0486            IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
18EE    0486            LOCATE (MENUZ MOD 6)*2+7,(INT((MENUZ/6)*28+2)-2*INT(MENUZ/12)
1938    0486            PRINT MENUS(MENUZ,0)
1956    0486            LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1969    0486            PRINT USING MENUS(MENUZ,1);MENU(MENUZ,0);
1939    0486            RETURN
192F    0486    REM SPACE
```

```
'Reagent Jet Printer                                                    PAGE
Pattern Printing                                                        09-17
                                                                        08:45
                                                IBM Personal Computer BASIC Compiler V2

    Offset  Data    Source Line

      1957  0436  '************ DATA USED BY THIS MODULE ************
      195F  0436
      195F  0436  &RDDATA:
      1964  0436          DATA "Dot Frequency      Hz","##,###",10000,1,1,16
      1966  0436          DATA "Amplitude          V ","###",150,0,1,19
      1968  0436          DATA "Stroke Delay       uS","##,###.#",15999.5,.5..5,16
      196A  0436          DATA "Pulse Width          ","###",999,0,1,19
      196C  0436          DATA "Rise Time            ","###",999,0,1,19
      196E  0436          DATA "Fall Time            ","###",999,0,1,19
      1970  0436          DATA "Grid Size          in","#.###",.005..005,45
      1972  0436          DATA "Repeat Count         ","##",99,0,1,47
      1974  0436          DATA "X Axis Offset      in","#.###",2,0,.005,45
      1976  0436          DATA "Y Axis Offset      in","#.###",2,0,.005,45
      1978  0436          DATA "","",0,0,0,0
      197A  0436          DATA "","",0,0,0,0
      197C  0436          DATA "Row to Print         ","##",99,1,1,74
      197E  0436          DATA "Colum to Print       ","##",99,1,1,74
      1980  0436          DATA "Row Spacing          in","#.###",3,0,.005,72
      1982  0436          DATA "Colum Spacing        in","#.###",3,0,.005,72
      1984  0436          DATA "","",0,0,0,0
      1986  0436          DATA "","",0,0,0,0
      1988  0436
      1988  0436    TABLE:
      198D  0436          DATA 3,1,218
      198F  0436          DATA 3,28,210
      1991  0436          DATA 3,54,210
      1993  0436          DATA 3,80,191
      1995  0436          DATA 5,1,198
      1997  0436          DATA 5,28,206
      1999  0436          DATA 5,54,206
      199B  0436          DATA 5,80,181
      199D  0436          DATA 18,1,192
      199F  0436          DATA 18,28,208
      19A1  0436          DATA 18,54,208
      19A3  0436          DATA 15,80,217
      19A5  0436
      19A5  0436    END SUB
      19AC  0436
      19AC  0436
      2049  0436

    50426 Bytes Available
    44716 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006 '$INCLUDE: 'Reagent Jet Printer' $SUBTITLE: 'Reagent Filing'
0030 0006 'MODULE  - "REAFILE" File Handling for reagents
0030 0006 '
0030 0006 'AUTHOR  - M. A. Enevold
0030 0006 '
0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006 '
0030 0006 'REVISION - 1.1 03-07-86 MAE Added notes and description
0030 0006 '           1.0 02-14-86 MAE Creation of initial code
0030 0006 '
0030 0006 'SYSTEM  - This code can only be compiled by the BASCOM
0030 0006 '           COMPILER, it will not run under the INTERPRETER!!
0030 0006 '
0030 0006 'DESCRIPTION:
0030 0006 '       This module allow file handling for reagents.  When inv
                  oked, it displays
0030 0006 '       the current contents of the reagent directory in 4 colu
                  mns of 20 entries
0030 0006 '       each.  The reagent which is currently selected for prin
                  ting is marked by
0030 0006 '       an asterisk to the left of the reagent name.  After the
                   directory is listed
0030 0006 '       the user is presented with 5 menu choices.  The left an
                  d right arrows are
0030 0006 '       used to highlight menu items and the enter key is used
                  to invoke action.
0030 0006 '       The menu choices and their actions are:
0030 0006 '
0030 0006 '             DELETE - Remove a reagent file from the directo
                  ry
0030 0006 '             COPY -   Copy a reagent file to a new reagent n
                  ame, saving the old reagent
0030 0006 '             RENAME - Change the name of the reagent without
                   changing the reagent itself
0030 0006 '             SELECT - Selct a reagent for printing
0030 0006 '             EXIT -   Return to the main menu
0030 0006 '
0030 0006 'DATA DICTIONARY
0030 0006 '       TYPE%      Which type of valid key was pushed
0030 0006 '       MENU%      Which menu item is being pointer to (0-4)
0030 0006 '       DIFF%      Distance to move MENU% at left or right arro
                  w
0030 0006 '       FLAG%      Error type 0-4
0030 0006 '       POINTER%   Position of REANAME$ in directory list
0030 0006 '       REANUM%          Number of reagent names in directory
                   list
0030 0006 '       TEMP%      Storage for integers during reagent copy
0030 0006 '       A$         Misc. input string
0030 0006 '       FUNCT$     Printed at bottom of screen during prompt fo
                  r reagent name
0030 0006 '       REANAME$   Reagent name currently being worked on
0030 0006 '       SELNAME$   Reagent name currently selected for printing
0030 0006 '       FILE$      Filename of reagent data file
0030 0006 '       SFILE$     Filename for source reagent data file used d
```

```
                  during copy
0030  0006  '       DFILE$    Filename for destination reagent data file u
                  sed during copy
0030  0006  '       NEWNAME$  New reagent name for COPY and RENAME
0030  0006  '       TEMP$     Reagent names are held here as the directory
                   is being re-written
0030  0006  '       NEWFILE$  Destination filename used while copying reag
                  ent data files
0030  0006  '       MESSAGE$  A message printed at the bottom of the scree
                  n
0030  0006  '       MENU$(4,1) Array of strings containing the short and lo
                  ng menu names
0030  0006  '       ERRMSG$   Message printed when any error occurs
0030  0006  '       ERR$      Appended to ERRMSG$ to indicate nature of er
                  ror
0030  0006  REM $PAGE
```



```
0030  0006  SUB REAGENT.FILE STATIC
0047  0006
0047  0006        GOSUB INITIALIZE
004D  0006        TYPE1 = 0
0054  0008
0054  0008        WHILE TYPE1 <> 3
005F  0008              A$ = ""
0069  000C              WHILE A$ = ""
0078  000C                    A$ = INKEY$
0082  000C              WEND
0085  000C              IF A$ = CHR$(0) + CHR$(75) THEN TYPE1 = 1:
                  'left arrow
00AA  000C              IF A$ = CHR$(0) + CHR$(77) THEN TYPE1 = 2:
                  'right arrow
00CF  000C              IF A$ = CHR$(13) THEN TYPE1 = 3:
                  '(cr) to execute selection
00E9  000C
00E9  000C                    ON TYPE1 GOSUB T1, T2, T3
00F8  000C        WEND
00FC  000C
00FC  000C        EXIT SUB
0100  000C
0100  000C  REM $PAGE
```

```
0100  000C     '******** SUB-ROUTINES FOR THIS MODULE ********
0100  000C
0100  000C  T1:          'left arrow
0105  000C          TYPE% = 0
010C  000C          IF MENU% = 0 THEN RETURN
011B  000E          DIFF% = -1
0122  0010          GOSUB MEN.MENU
0128  0010          RETURN
012C  0010
012C  0010  T2:          'right arrow
0131  0010          TYPE% = 0
0138  0010          IF MENU% = 4 THEN RETURN
0147  0010          DIFF% = 1
014E  0010          GOSUB MEN.MENU
0154  0010          RETURN
015B  0010
015B  0010  T3:          '(cr)  (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACE$(79);
017A  0010          ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F  0010          GOSUB MENU.ON
0195  0010          RETURN
0199  0010
0199  0010  MEN $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0199  0010  T3A:          'delete reagent
019E  0010          TYPE% = 0
01A5  0010          FUNCT$ = "Delete"
01AF  0014          GOSUB GET.SOURCE
01B5  0014          IF LEN(REANAME$) = 0 THEN RETURN
01C7  0018          IF REANAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                    RETURN
01E7  001E          GOSUB SEARCH
01ED  001E          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
0209  0020
0209  0020          MESSAGE$ = "Deleting " + REANAME$ + "     Please Wait..
                    ."
0220  0024          GOSUB MESSAGE.ON
0226  0024
0226  0024                  'rewrite directory deleting REANAME$ as indicat
                    ed by POINTER%
0226  0024          KILL "READIR.OLD"
022D  0024          NAME "READIR.RJP" AS "READIR.OLD"
0237  0024          OPEN "READIR.OLD" FOR INPUT AS #1
0248  0024          OPEN "READIR.RJP" FOR OUTPUT AS #2
025A  0024
025A  0024          INPUT #1, REANUM%
026C  0026          REANUM% = REANUM% - 1
0275  0026          WRITE #2,REANUM%
0286  0026
0286  0026          IF REANUM% = 0 THEN GOTO DIR.DONE
0295  0026          FOR I% = 1 TO REANUM% + 1
02A4  0028                  INPUT #1,REANAME$
02B6  0028                  IF I% <> POINTER% THEN PRINT #2,REANAME$
02D3  002A          NEXT I%
02E5  002A
02E5  002A    DIR.DONE:
02EA  002A          CLOSE #1:CLOSE #2
02FB  002A
02FB  002A                  'remove data file
02FB  002A          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                    "REA.RJP"
031C  002E          KILL FILE$
0323  002E
0323  002E                  'rename remaining data files to maintain linked
                     list to directory
0323  002E          WHILE (REANUM% + 1) > POINTER%
0333  002E                  SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                    ER%+1))-1) + "REA.RJP"
0359  0032                  DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                    %))-1) + "REA.RJP"
037D  0036                  NAME SFILE$ AS DFILE$
0387  0036                  POINTER% = POINTER% + 1
0390  0036          WEND
0393  0036
0393  0036          GOSUB MESSAGE.OFF
0399  0036          REANAME$ = SELNAME$
03A3  0036          GOSUB T3DA
03A9  0036          GOSUB DISP.DIR
```

```
Reagent Jet Printer                                          PAGE  6
Reagent Filing                                               07-09-86
                                                             15:04:35
Offset  Data    Source Line        IBM Personal Computer BASIC Compiler V2.00

03AF    0036            RETURN
03B3    0036
03B3    0036    REM $PAGE
```

Offset Data Source Line (3% Personal Computer BASIC Compiler V2.00

```
03B3  0036  TJB:    'copy reagent
03B8  0036          TYPE% = 0
03BF  0036          IF REANUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
03DB  0036          FUNCT$ = "Copy"
03E5  0036          GOSUB GET.SOURCE
03EB  0036          IF LEN(REANAME$) = 0 THEN RETURN
03FD  0036          GOSUB SEARCH
0403  0036          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
041F  0036
041F  0036          GOSUB GET.NEW.NAME
0425  0036          IF LEN(NEWNAME$) = 0 THEN RETURN
0437  003A          IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                  ETURN
0457  003A
0457  003A          MESSAGE$ = "Copying " + REANAME$ + " to " + NEWNAME$ +
                  "    Please wait.."
047C  003A          GOSUB MESSAGE.ON
0482  003A
0482  003A              'add new name at end of directory
0462  003A          KILL "READIR.OLD"
0489  003A          NAME "READIR.RJP" AS "READIR.OLD"
0493  003A          OPEN "READIR.OLD" FOR INPUT AS #1
04A4  003A          OPEN "READIR.RJP" FOR OUTPUT AS #2
04B6  003A
04B6  003A          INPUT #1, REANUM%
04CB  003A          REANUM% = REANUM% + 1
04D1  003A          WRITE #2,REANUM%
04E2  003A
04E2  003A          FOR I% = 1 TO REANUM% - 1
04F1  003C                  INPUT #1,TEMP$
0503  0040                  PRINT #2,TEMP$
0513  0040          NEXT I%
0525  0040          PRINT #2,NEWNAME$
0535  0040
0535  0040          CLOSE #1:CLOSE #2
0543  0040
0543  0040              'create copy of data file
0543  0040          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                  "REA.RJP"
0567  0040          NEWFILE$ = RIGHT$(STR$(REANUM%),LEN(STR$(REANUM%))-1) +
                   "REA.RJP"
058B  0044
058B  0044          OPEN FILE$ FOR INPUT AS #1
059C  0044          OPEN NEWFILE$ FOR OUTPUT AS #2
05AE  0044
05AE  0044          INPUT #1,TEMP
05C0  0048          WRITE #2,TEMP:  'frequency
05D0  0048          INPUT #1,TEMP
05E2  0048          WRITE #2,TEMP:  'pulse width
05F2  0048          INPUT #1,TEMP
0604  0048          WRITE #2,TEMP:  'strobe delay
0614  0048          INPUT #1,TEMP
0626  0048          WRITE #2,TEMP:  'nozzle
0636  0048
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0636    0048            INPUT #1,TEMP$
0648    0048            PRINT #2,TEMP$:         'concentration
065B    0048            INPUT #1,TEMP$
066A    0048            PRINT #2,TEMP$:         'density
067A    0048            INPUT #1,TEMP$
068C    0048            PRINT #2,TEMP$:         'viscosity
069C    0048
069C    0048            CLOSE #1:CLOSE #2
06AA    0048
06AA    0048            GOSUB MESSAGE.OFF
06B0    0048            GOSUB DISP.DIR
06B6    0048            RETURN
06BA    0048
06BA    0048    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
06BA  0046  TCC:    'rename reagent
06BF  0048          TYPE% = 0
06C6  0048          FUNCT$ = "Rename"
06D0  0048          GOSUB GET.SOURCE
06D6  0048          IF LEN(REANAME$) = 0 THEN RETURN
06E8  0048          GOSUB SEARCH
06EE  0048          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
070A  0048
070A  0048          GOSUB GET.NEW.NAME
0710  0048          IF LEN(NEWNAME$) = 0 THEN RETURN
0722  0048          IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                ETURN
0742  0048          IF NEWNAME$ = REANAME$ THEN RETURN
0755  0048          MESSAGE$ = "Renaming " + REANAME$ + " to " + NEWNAME$ +
                "    Please wait.."
077A  0048          GOSUB MESSAGE.ON
0780  0048
0790  0048              'renaming reagent name in directory
0780  0048          KILL "READIR.OLD"
0787  0048          NAME "READIR.RJP" AS "READIR.OLD"
0791  0048          OPEN "READIR.OLD" FOR INPUT AS #1
07A2  0048          OPEN "READIR.RJP" FOR OUTPUT AS #2
07B4  0048
07B4  0048          INPUT #1, REANUM%
07C6  0048          WRITE #2,REANUM%
07D7  0048
07D7  0048          FOR I% = 1 TO REANUM%
07E4  004A              INPUT #1,TEMP$
07F6  004A              IF I% <> POINTER% THEN PRINT #2,TEMP$
0813  004A              IF I% = POINTER% THEN PRINT #2,NEWNAME$
0830  004A          NEXT I%
0842  004A
0842  004A          CLOSE #1:CLOSE #2
0850  004A
0850  004A          GOSUB MESSAGE.OFF
0856  004A          IF REANAME$ = SELNAME$ THEN REANAME$ = NEWNAME$:GOSUB T
                DA
0875  004A          GOSUB DISP.DIR
087B  004A          RETURN
087F  004A
087F  004A      REM SPACE
```

```
Offset  Data    Source Line
 067F   004A    TOP:    'select reagent for printing
 0683   004B            "AREA = 0
 0885   004A            PUNCTS = "Select"
 0895   004A            GOSUB GET.SOURCE
 0893   004A            IF LEN(REANAMES$) = 0 THEN RETURN
 08AB   004A            IF REANAMES = SELNAMES$ THEN RETURN
 08C3   004A            GOSUB T3DA
 08C6   004A            GOSUB DISP.DIR
 08CC   004A            RETURN
 08D0   004A
 08D0   004A    T3DA:
 08D5   004A            GOSUB SEARCH
 08DB   004A            IF POINTER2 = 0 THEN FLAG2 = 1:GOSUB SHOW.ERROR:RETURN
 08F7   004A
 08F7   004A            MESSAGE$ = "Selecting " + REANAME$ + "     Please Wait.
                ..."
 090E   004A            GOSUB MESSAGE.ON
 0914   004A
 0914   004A                    'change entrys in reagent default file READEF.R
                EP
 0914   004A            OPEN "READEF.REP" FOR OUTPUT AS #1
 0926   004A            FILE$ = RIGHT$(STR$(POINTER2),LEN(STR$(POINTER2))-1) +
                "REA.REP"
 094A   004A
 094A   004A            PRINT #1,FILE$
 095A   004A            PRINT #1,REANAME$
 096A   004A
 096A   004A            CLOSE #1
 0971   004A            GOSUB MESSAGE.OFF
 0977   004A            RETURN
 097B   004A
 097B   004A    TOE:    'exit reagent filing
 0980   004A            RETURN
 0984   004A
 0984   004A    REM SPACE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
0984    004A    SEARCH:
0989    004A            POINTER% = 0
0990    004A            OPEN "READIR.RJP" FOR INPUT AS #1
09A1    004A            INPUT #1,REANUM%:'      get number of reagents in direc
                tory
09B3    004A            IF REANUM% = 0 THEN CLOSE #1:RETURN
09C9    004A            TEMP$ = ""
09D3    004A            WHILE (POINTER% < REANUM%) AND (REANAME$ <> TEMP$)
09FB    004A                    LINE INPUT #1,TEMP$
0A06    004A                    POINTER% = POINTER% + 1
0A11    004A            WEND
0A14    004A            IF REANAME$ <> TEMP$ THEN POINTER% = 0
0A2A    004A            CLOSE #1
0A31    004A            RETURN
0A35    004A
0A35    004A    GET.SOURCE:
0A3A    004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU
                NCT$"  ";
0A6C    004A            LINE INPUT;"",REANAME$
0A7A    004A            LOCATE 25,1:PRINT SPACE$(79);
0A97    004A            RETURN
0A9B    004A
0A9B    004A    GET.NEW.NAME:
0AA0    004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
0AC6    004A            LINE INPUT;"",NEWNAME$
0AD4    004A            LOCATE 25,1:PRINT SPACE$(79);
0AF1    004A            RETURN
0AF5    004A
0AF5    004A    DISP.DIR:       'display reagent directory in 4 columns of 20 r
                ows
0AFA    004A                    'read selected reagent into SELNAME$
0AFA    004A            OPEN "READEF.RJP" FOR INPUT AS #1
0B0B    004A            INPUT #1,SELNAME$:      'read and discard data file nam
                e
0B1D    004A            INPUT #1,SELNAME$:      'read and save reagent name
0B2F    004A            CLOSE #1
0B36    004A
0B36    004A            OPEN "READIR.RJP" FOR INPUT AS #1
0B47    004A            INPUT #1,REANUM%:'      read number of reagents
0B59    004A            MESSAGE$ = "Reading Reagent Directory  Please Wait"
0B63    004A            GOSUB MESSAGE.ON
0B69    004A            FLAG% = 0
0B70    004A            TEMP% = REANUM% - 1:IF REANUM% < 80 THEN TEMP% = REANUM
                %
0B8B    004C            FOR I% = 0 TO TEMP%
0B97    004E                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
0BCA    004E                    PRINT SPACE$(18);
0BDA    004E            NEXT I%
0BEC    004E
0BEC    004E            FOR I% = 0 TO REANUM% - 1
0BFA    0050                    INPUT #1,REANAME$
0C0C    0050                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
0C3F    0050                    PRINT REANAME$;
0C4C    0050                    IF REANAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
```

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```
                1,(INT(I%/20)*20)+1:PRINT "*";
 0C9E   0050            NEXT I%
 0CB0   0050            CLOSE #1
 0CB7   0050            GOSUB MESSAGE.OFF
 0CBD   0050            RETURN
 0CC1   0050
 0CC1   0050    INITIALIZE:
 0CC6   0050            DIM MENUS(4,1)
 0CC7   0078            MENUS(0,0) = "Delete"
 0CDF   0078            MENUS(0,1) = "Remove a reagent file from the directory"
 0CFA   0078            MENUS(1,0) = "Copy"
 0D15   0078            MENUS(1,1) = "Copy a reagent file to a new reagent name
                 .
 0D3E   0078            MENUS(2,0) = "Rename"
 0D4B   0078            MENUS(2,1) = "Rename a reagent file in the directory"
 0D69   0078            MENUS(3,0) = "Select"
 0D84   0078            MENUS(3,1) = "Select a reagent file to be printed"
 0DA0   0078            MENUS(4,0) = "Exit"
 0DBB   0078            MENUS(4,1) = "Return to the main menu"
 0DD7   0078
 0DD7   0078            COLOR 7,0:CLS
 0DEA   0078            LOCATE 21,1
 0DF7   0078            FOR I% = 1 TO 80
 0DFE   0078                    PRINT "D";
 0E0B   0078            NEXT I%
 0E1B   0078
 0E1B   0078            FOR MENU% = 0 TO 4
 0E21   0078                    GOSUB MENU.OFF
 0E27   0078            NEXT MENU%
 0E37   0078
 0E37   0078            GOSUB DISP.DIR
 0E3D   0078            IF FLAG% > 0 THEN GOSUB SHOW.ERROR
 0E4E   0078            MENU% = 4
 0E55   0078            GOSUB MENU.ON
 0E5B   0078
 0E5B   0078            RETURN
 0E5F   0078
 0E5F   0078    NEW.MENU:
 0E64   0078            GOSUB MENU.OFF
 0E6A   0078            MENU% = MENU% + DIFF%
 0E76   0078            GOSUB MENU.ON
 0E7C   0078            RETURN
 0E80   0078
 0E80   0078    MENU.ON:
 0E85   0078            LOCATE 22,(MENU%*10)+18
 0E9C   0078            COLOR 0,7
 0EAB   0078            PRINT MENUS(MENU%,0);
 0EC6   0078            LOCATE 25,40-LEN(MENUS(MENU%,1))/2
 0EFA   0078            COLOR 7,0
 0F06   0078            PRINT MENUS(MENU%,1);
 0F25   0078            RETURN
 0F29   0078
 0F29   0078    MENU.OFF:
 0F2E   0078            LOCATE 22,(MENU%*10)+18
```

```
Reagent Jet Printer                                                    PAGE  13
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0F45   0078            COLOR 14,0
 0F51   0078            PRINT MENUS(MENUZ,0);
 0F6F   0078            LOCATE 25,40-LEN(MENUS(MENUZ,1))/2
 0FA3   0078            PRINT SPACES(LEN(MENUS(MENUZ,1)));
 0FCB   0078            RETURN
 0FCC   0078
 0FCC   0078    SHOW.ERROR:
 0FD1   0078            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0FE2   0078            ERRMSG$ = ERR$ + "     Strike any key.."
 0FF2   0080            LOCATE 24,40-LEN(ERRMSG$)/2
 1014   0080            COLOR 13,0
 1020   0080            PRINT ERRMSG$;
 102D   0080            A$ = ""
 1037   0080            WHILE A$ = ""
 1046   0080                  A$ = INKEY$
 1050   0080            WEND
 1053   0080            GOSUB MESSAGE.OFF
 1059   0080            RETURN
 105D   0080
 105D   0080    ER1:
 1062   0080            ERR$ = REANAME$ + " Not Found in the Directory"
 1072   0080            RETURN
 1076   0080
 1076   0080    ER2:
 107B   0080            ERR$ = "Reagent Name is too Long (15 characters max.)"
 1085   0080            RETURN
 1089   0080
 1089   0080    ER3:
 108E   0080            ERR$ = "Directory is Full (80 reagents max.)"
 1098   0080            RETURN
 109C   0080
 109C   0080    ER4:
 10A1   0080            ERR$ = "Cannot Modify SELECTd reagent Name"
 10AB   0080            RETURN
 10AF   0080
 10AF   0080    MESSAGE.ON:
 10B4   0080            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                        GE$;
 10EF   0080            RETURN
 10F3   0080
 10F3   0080
 10F3   0080    MESSAGE.OFF:
 10FB   0080            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 1121   0080            RETURN
 1125   0080
 1125   0080    END SUB
 112C   0080
 16C9   0080

50426 Bytes Available
45718 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data    Source Line
0030    0006    REM $TITLE:'Reagent Jet Printer  $SUBTITLE:'Pattern Filing'
0030    0006    'MODULE   - 'PATFILE' File Handling for patterns
0030    0006    '
0030    0006    'AUTHOR   - M. A. Enevold
0030    0006    '
0030    0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    '
0030    0006    'REVISION - 1.0 02-12-86 MAE Creation of initial code
0030    0006    '
0030    0006    'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006    '           COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    'DESCRIPTION:
0030    0006    '       This module allow file handling for patterns.  When inv
                oked, it displays
0030    0006    '       the current contents of the pattern directory in 4 colu
                mns of 20 entries
0030    0006    '       each.  The pattern which is currently selected for prin
                ting is marked by
0030    0006    '       an asterisk to the left of the pattern name.  After the
                 directory is listed
0030    0006    '       the user is presented with 5 menu choices.  The left an
                d right arrows are
0030    0006    '       used to highlight menu items and the enter key is used
                to invoke action.
0030    0006    '       The menu choices and their actions are:
0030    0006    '
0030    0006    '               DELETE - Remove a pattern file from the directo
                ry
0030    0006    '               COPY -   Copy a pattern file to a new pattern n
                ame, saving the old pattern
0030    0006    '               RENAME - Change the name of the pattern without
                 changing the pattern itself
0030    0006    '               SELECT - Selct a pattern for printing
0030    0006    '               EXIT -   Return to the main menu
0030    0006    '
0030    0006    'DATA DICTIONARY
0030    0006    '       TYPE%       Which type of valid key was pushed
0030    0006    '       MENU%       Which menu item is being pointer to (0-4)
0030    0006    '       DIFF%       Distance to move MENU% at left or right arro
                w
0030    0006    '       FLAG%       Error type 0-4
0030    0006    '       POINTER%    Position of PATHNAME$ in directory list
0030    0006    '       PATHNUM%            Number of pattern names in directory
                 list
0030    0006    '       ELNUM%      Number of elements in a pattern file
0030    0006    '       TEMP%       Storage for integers during pattern copy
0030    0006    '       I%          Counter used during pattern copy
0030    0006    '       J%          Counter used during pattern copy
0030    0006    '       A$          Misc. input string
0030    0006    '       FUNCT$      Printed at bottom of screen during prompt fo
                r pattern name
0030    0006    '       PATHNAME$   Pattern name currently being worked on
0030    0006    '       SELNAME$    Pattern name currently selected for printing
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006 '       FILE$      Filename of pattern data file
0030 0006 '       SFILE$     Filename for source pattern data file used d
uring copy
0030 0006 '       DFILE$     Filename for destination pattern data file u
sed during copy
0030 0006 '       NEWNAME$   New pattern name for COPY and RENAME
0030 0006 '       TEMP$      Pattern names are held here as the directory
 is being re-written
0030 0006 '       NEWFILE$   Destination filename used while copying patt
ern data files
0030 0006 '       MESSAGE$   A message printed at the bottom of the scree
n
0030 0006 '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
0030 0006 '       ERRMSG$    Message printed when any error occurs
0030 0006 '       ERR$       Appended to ERRMSG$ to indicate nature of er
ror
0030 0006 '       TEMP       Storage of real variables while copying patt
ern data files
0030 0006 REM $PAGE
```


Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006 SUB PATTERN.FILE STATIC
0047 0006
0047 0006         GOSUB INITIALIZE
004D 0006         TYPE% = 0
0054 0008
0054 0008         WHILE TYPE% <> 3
005F 0008                 A$ = ""
0069 000C                 WHILE A$ = ""
0078 000C                         A$ = INKEY$
0082 000C                 WEND
0085 000C                 IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 1:
'left arrow
00AA 000C                 IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 2:
'right arrow
00CF 000C                 IF A$ = CHR$(13) THEN TYPE% = 3:
'(cr) to execute selection
00E9 000C
00E9 000C                         ON TYPE% GOSUB T1, T2, T3
00FB 000C         WEND
00FC 000C
00FC 000C         EXIT SUB
0100 000C
0100 000C REM $PAGE
```

```
Offset  Data    Source Line

0100    000C    '******** SUB-ROUTINES FOR THIS MODULE ********
0100    000C
0100    000C    T1:             'left arrow
0105    000C            TYPE1 = 0
010C    000C            IF MENU1 = 0 THEN RETURN
011B    000E            DIFF1 = -1
0122    0010            GOSUB NEW.MENU
012B    0010            RETURN
012C    0010
012C    0010    T2:             'right arrow
0131    0010            TYPE1 = 0
013B    0010            IF MENU1 = 4 THEN RETURN
0147    0010            DIFF1 = 1
014E    0010            GOSUB NEW.MENU
0154    0010            RETURN
015B    0010
015B    0010    T3:             '<cr>  (execute selected menu item)
015D    0010            LOCATE 25,1:PRINT SPACE$(79);
017A    0010            ON MENU1 + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F    0010            GOSUB MENU.ON
0195    0010            RETURN
0199    0010
0199    0010    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
6
 0199   0010    T3A:            delete pattern
 019E   0010            TYPE% = 0
 01A5   0010            FUNCT$ = "Delete"
 01AF   0014            GOSUB GET.SOURCE
10 01B5 0014            IF LEN(PATNAME$) = 0 THEN RETURN
 01C7   0018            IF PATNAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                    RETURN
 01E7   001E            GOSUB SEARCH
 01ED   001E            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
15 0209 0020
 0209   0020            MESSAGE$ = "Deleting " + PATNAME$ + "     Please Wait..
                    "
 0220   0024            GOSUB MESSAGE.ON
 0226   0024
20 0226 0024                    'rewrite directory deleting PATNAME$ as indicat
                    ed by POINTER%
 0226   0024            KILL "PATDIR.OLD"
 022D   0024            NAME "PATDIR.RJP" AS "PATDIR.OLD"
 0237   0024            OPEN "PATDIR.OLD" FOR INPUT AS #1
25 0248 0024            OPEN "PATDIR.RJP" FOR OUTPUT AS #2
 025A   0024
 025A   0024            INPUT #1, PATNUM%
 026C   0026            PATNUM% = PATNUM% - 1
 0275   0026            WRITE #2,PATNUM%
30 0286 0026
 0286   0026            IF PATNUM% = 0 THEN GOTO DIR.DONE
 0295   0026            FOR I% = 1 TO PATNUM% + 1
 02A4   0028                    INPUT #1,PATNAME$
 02B6   0028                    IF I% <> POINTER% THEN PRINT #2,PATNAME$
35 02D3 002A            NEXT I%
 02E5   002A
 02E5   002A    DIR.DONE:
 02EA   002A            CLOSE #1:CLOSE #2
 02FB   002A
40 02FB 002A                    'remove data file
 02FB   002A            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                    ".PAT.RJP"
 031C   002E            KILL FILE$
 0323   002E
45 0323 002E                    'rename remaining data files to maintain linked
                     list with directory
 0323   002E            WHILE (PATNUM% + 1) > POINTER%
 0333   002E                    SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                    ER%+1))-1) + ".PAT.RJP"
50 0359 0032                    DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                    %))-1) + ".PAT.RJP"
 037D   0036                    NAME SFILE$ AS DFILE$
 0387   0036                    POINTER% = POINTER% + 1
 039C   0036            WEND
55 0393 0036
 0393   0036            GOSUB MESSAGE.OFF
 0399   0036            PATNAME$ = SELNAME$
 03A3   0036            GOSUB T3DA
 03A9   0036            GOSUB DISP.DIR
```

Reagent Jet Printer
Pattern Filing

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line
 03AF   0036            RETURN
 03B3   0036
 03B3   0036    REM $PAGE
```

```
Offset  Data    Source Line        IBM Personal Computer BASIC Compiler V2.00

 03B3   0036    TOP:    'copy patterns
 03B8   0036             TYPE% = 0
 03BF   0036             IF PATNUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
 03D8   0036             FUNCT$ = "Copy"
 03E5   0036             GOSUB GET.SOURCE
 03EB   0036             IF LEN(PATNAME$) = 0 THEN RETURN
 03FC   0036             GOSUB SEARCH
 0403   0036             IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
 041F   0036             GOSUB GET.NEW.NAME
 0425   0036             IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A             IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                    ETURN
 0457   003A
 0457   003A             MESSAGE$ = "Copying " + PATNAME$ + " to " + NEWNAME$ +
                     "    Please wait.."
 047C   003A             GOSUB MESSAGE.ON
 0482   003A
 0482   003A                     'add NEWNAME$ at end of directory
 0482   003A             KILL "PATDIR.OLD"
 0489   003A             NAME "PATDIR.DAT" AS "PATDIR.OLD"
 0493   003A             OPEN "PATDIR.OLD" FOR INPUT AS #1
 04A4   003A             OPEN "PATDIR.DAT" FOR OUTPUT AS #2
 04B6   003A
 04B6   003A             INPUT #1, PATNUM%
 04C8   003A             PATNUM% = PATNUM% + 1
 04D1   003A             WRITE #2,PATNUM%
 04E2   003A
 04E2   003A             FOR I% = 1 TO PATNUM% - 1
 04F1   003C                     INPUT #1,TEMP$
 0503   0040                     PRINT #2,TEMP$
 0513   0040             NEXT I%
 0525   0040             PRINT #2,NEWNAME$
 0535   0040
 0535   0040             CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                     'create copy of pattern data file
 0543   0040             FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                     "PAT.DAT"
 0567   0040             NEWFILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) +
                      "PAT.DAT"
 0588   0044
 0586   0044             OPEN FILE$ FOR INPUT AS #1
 059C   0044             OPEN NEWFILE$ FOR OUTPUT AS #2
 05AE   0044
 05AE   0044             INPUT #1,ELNUM%
 05C0   0046             WRITE #2,ELNUM%
 05D1   0046
 05D1   0046             FOR I% = 1 TO 4
 05DB   0046                     INPUT #1,TEMP
 05EA   004A                     WRITE #2,TEMP
 05FA   004A             NEXT I%
 060A   004A
 060A   004A             FOR I% = 1 TO ELNUM%
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0842  0052          RETURN
0846  0052
0846  0052    REM $PAGE
```


Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0846  0052    TJD:          'select pattern for printing
084B  0052          TYPE% = 0
0852  0052          FUNCT$ = "Select"
085C  0052          GOSUB GET.SOURCE
0862  0052          IF LEN(PATNAME$) = 0 THEN RETURN
0874  0052          IF PATNAME$ = SELNAME$ THEN RETURN
0887  0052          GOSUB TJDA
088D  0052          GOSUB DISP.DIR
0893  0052          RETURN
0897  0052
0897  0052    TJDA:
089C  0052          GOSUB SEARCH
08A2  0052          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
08BE  0052
08BE  0052          MESSAGE$ = "Selecting " + PATNAME$ + "     Please Wait.
..."
08D5  0052          GOSUB MESSAGE.ON
08DB  0052
08DB  0052               'change entrys in pattern default file PATDEF.R
JP
08DB  0052          OPEN "PATDEF.RJP" FOR OUTPUT AS #1
08ED  0052          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
"PAT.RJP"
0911  0052
0911  0052          PRINT #1,FILE$
0921  0052          PRINT #1,PATNAME$
0931  0052
0931  0052          CLOSE #1
0938  0052          GOSUB MESSAGE.OFF
093E  0052          RETURN
0942  0052
0942  0052    TJE:      'exit pattern filing
0947  0052          RETURN
094B  0052
094B  0052    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0948   0052    SEARCH:
 0950   0052            POINTER% = 0
 0957   0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
 0968   0052            INPUT #1,PATNUM%:'      get number of patterns in direc
                tory
 097A   0052            IF PATNUM% = 0 THEN CLOSE #1:RETURN
 0990   0052            TEMP$ = ""
 099A   0052            WHILE (POINTER% < PATNUM%) AND (PATNAME$ <> TEMP$)
 09C2   0052                    LINE INPUT #1,TEMP$
 09CF   0052                    POINTER% = POINTER% + 1
 09D8   0052            WEND
 09DB   0052            IF PATNAME$ <> TEMP$ THEN POINTER% = 0
 09F1   0052            CLOSE #1
 09F8   0052            RETURN
 09FC   0052
 09FC   0052    GET.SOURCE:
 0A01   0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "U
                NCT$"  ";
 0A33   0052            LINE INPUT;"",PATNAME$
 0A41   0052            LOCATE 25,1:PRINT SPACE$(79);
 0A5E   0052            RETURN
 0A62   0052
 0A62   0052    GET.NEW.NAME:
 0A67   0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
 0ABD   0052            LINE INPUT;"",NEWNAME$
 0A9B   0052            LOCATE 25,1:PRINT SPACE$(79);
 0ABB   0052            RETURN
 0ABC   0052
 0ABC   0052    DISP.DIR:       'display directory in 4 columns, 20 rows
 0AC1   0052                    'read default pattern name into SELNAME$
 0AC1   0052            OPEN "PATDEF.RJP" FOR INPUT AS #1
 0AD2   0052            INPUT #1,SELNAME$:      'discard data file name
 0AE4   0052            INPUT #1,SELNAME$
 0AF6   0052            CLOSE #1
 0AFD   0052
 0AFD   0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
 0B0E   0052            INPUT #1,PATNUM%:'      read number of patterns
 0B20   0052
 0B20   0052            MESSAGE$ = "Reading Pattern Directory  Please Wait"
 0B2A   0052            GOSUB MESSAGE.ON
 0B30   0052            FLAG% = 0
 0B37   0052            TEMP% = PATNUM% - 1:IF PATNUM% < 80 THEN TEMP% = PATNUM
                %
 0B52   0052            FOR I% = 0 TO TEMP%
 0B5E   0054                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
 0B91   0054                    PRINT SPACE$(18);
 0BA1   0054            NEXT I%
 0BB3   0054
 0BB3   0054            FOR I% = 0 TO PATNUM% - 1
 0BC1   0056                    INPUT #1,PATNAME$
 0BD3   0056                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
 0C06   0056                    PRINT PATNAME$;
 0C13   0056                    IF PATNAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
                1,(INT(I%/20)*20)+1:PRINT "*";
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0C62  0056          SETT I%
0C77  0056          CLOSE #1
0C7E  0056          GOSUB MESSAGE.OFF
0C84  0056          RETURN
0C86  0056
0C82  0053  INITIALIZE:
0C8D  0056          DIM MENU$(4,1)
0C8E  007E          MENU$(0,0) = "Delete"
0CA6  007E          MENU$(0,1) = "Remove a pattern file from the directory"
0CC1  007E          MENU$(1,0) = "Copy"
0CDC  007E          MENU$(1,1) = "Copy a pattern file to a new pattern name
                    "
0CF5  007E          MENU$(2,0) = "Rename"
0D12  007E          MENU$(2,1) = "Rename a pattern file in the directory"
0D30  007E          MENU$(3,0) = "Select" _
0D4B  007E          MENU$(3,1) = "Select a pattern file to be printed"
0D67  007E          MENU$(4,0) = "Exit"
0D82  007E          MENU$(4,1) = "Return to the main menu"
0D9E  007E
0D9E  007E          COLOR 9,0:CLS
0DB1  007E          LOCATE 21,1
0DBE  007E          FOR II = 1 TO 80
0DC5  007E                  PRINT "D";
0DD2  007E          NEXT II
0DE2  007E
0DE2  007E          FOR MENUI = 0 TO 4
0DEB  007E                  GOSUB MENU.OFF
0DEE  007E          NEXT MENUI
0DFE  007E
0DFE  007E          GOSUB DISP.DIR
0E04  007E          IF FLAG% > 0 THEN GOSUB SHOW.ERROR
0E15  007E          MENUI = 4
0E1C  007E          GOSUB MENU.ON
0E22  007E
0E22  007E          RETURN
0E26  007E
0E26  007E  NEW.MENU:
0E2B  007E          GOSUB MENU.OFF
0E31  007E          MENUI = MENUI + DIFFI
0E3D  007E          GOSUB MENU.ON
0E43  007E          RETURN
0E47  007E
0E47  007E  MENU.ON:
0E4C  007E          LOCATE 22,(MENUI*10)+18
0E63  007E          COLOR 0,7
0E6F  007E          PRINT MENU$(MENUI,0);
0E8D  007E          LOCATE 25,40-LEN(MENU$(MENUI,1))/2
0EC1  007E          COLOR 7,0
0ECD  007E          PRINT MENU$(MENUI,1);
0EEC  007E          RETURN
0EF0  007E
0EF0  007E  MENU.OFF:
0EF5  007E          LOCATE 22,(MENUI*10)+18
0F0C  007E          COLOR 14,0
```

```
Offset  Data    Source Line
 0F18   007E            PRINT MENU$(MENUZ,0);
 0F36   007E            LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
 0F6A   007E            PRINT SPACE$(LEN(MENU$(MENUZ,1)));
 0F8F   007E            RETURN
 0F93   007E
 0F93   007E    SHOW.ERROR:
 0F9B   007E            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0FA9   007E            ERRMSG$ = ERR$ + "     Strike any key.."
 0FB9   0086            LOCATE 24,40-LEN(ERRMSG$)/2
 0FDB   0086            COLOR 13,0
 0FE7   0086            PRINT ERRMSG$;
 0FF4   0086            A$ = ""
 0FFE   0086            WHILE A$ = ""
 100D   0086                    A$ = INKEY$
 1017   0066            WEND
 101A   0086            GOSUB MESSAGE.OFF
 1020   0086            RETURN
 1024   0086
 1024   0086    ER1:
 1029   0086            ERR$ = PATHNAME$ + " Not Found in the Directory"
 1039   0086            RETURN
 103D   0086
 103D   0086    ER2:
 1042   0086            ERR$ = "Pattern Name is too Long (15 characters max.)"
 104C   0086            RETURN
 1050   0086
 1050   0086    ER3:
 1055   0086            ERR$ = "Directory is Full (80 patterns max.)"
 105F   0086            RETURN
 1063   0086
 1063   0066    ER4:
 1068   0086            ERR$ = "Cannot Modify SELECTd pattern Name"
 1072   0086            RETURN
 1076   0086
 1076   0086    MESSAGE.ON:
 107B   0086            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 10B6   0086            RETURN
 10BA   0086
 10BA   0086
 10BA   0086    MESSAGE.OFF:
 10BF   0086            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 10EB   0086            RETURN
 10EC   0086
 10EC   0086    END SUB
 10F3   0086
 1688   0086

50426 Bytes Available
45670 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
                (5)
 0030   0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Main Line Code'
 0030   0006
 0030   0006    'MODULE   - "MAIN"
 0030   0006
 0030   0006    'AUTHOR   - M. A. Enevold
 0030   0006
 0030   0006    'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
 0030   0006
 0030   0006    'REVISION - 1.1 02-19-86 MAE Add notes and revise TYPE% resetin
                g
 0030   0006    '         - 1.0 02-14-86 MAE Creation of initial code
 0030   0006
 0030   0006    'SYSTEM   - This code can only be compiled by the BASCOM
 0030   0006    '           COMPILER, it will not run under the INTERPRETER!!
 0030   0006
 0030   0006    'DESCRIPTION
 0030   0006    '       This is the main controlling module for the Reagent Jet
                 Printer.
 0030   0006    '       It displays a menu in table form that allows 6 function
                s to be
 0030   0006    '       selected.  PATTERN DEFINITION allows the user to define
                 patterns
 0030   0006    '       to be printed.  PATTERN FILING lets the user delete, co
                py, rename
 0030   0006    '       and select patterns for printing.  REAGENT CALIBRATION
                permits setting
 0030   0006    '       of operation parameters for different reagents.  REAGEN
                T FILING is
 0030   0006    '       the same as pattern filing.  PRINTING PRINT prints the
                selected
 0030   0006    '       pattern with the selected reagent.  SYSTEM EXIT TO DOS
                ends the session.
 0030   0006    '       Using up and down arrow keys let the user move through
                the menu and
 0030   0006    '       the Enter <cr> key activates the selection.
 0030   0006
 0030   0006    'DATA DICTIONARY
 0030   0006    '       MENU%           This value represents the current menu
                item (0-5)
 0030   0006    '       MENU$(5,1)      String array for displaying menu items.
                  6 rows by 2 columns
 0030   0006    '                       Each row corresponds to a menu item (0-
                5)
 0030   0006    '                       First column is short menu name in high
                lighted area
 0030   0006    '                       Second column is long description displ
                ayed at menu bottom
 0030   0006    '       ARROW%(5)       This array stores to row in which the s
                hort menu name will be displayed
 0030   0006    '       DIFF%           This value is used it change MENU% in r
                esponse to arrow keys
 0030   0006    '       TYPE%           This value is set based on which valid
                key is pressed
 0030   0006    '                       0 = No valid key.  1 = Up Arrow.  2 = D
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

                own Arrow.  3 = (CR).
 0030   0006    '       TEMP1        Used to store MENU1 while screen is ref
                reshed
 0030   0006    '       A$           Used to store single input keystrokes
 0030   0006    '       C$           Used to store special graphics characte
                rs used in drawing the menu table
 0030   0006    '       I1           Counter used to refresh display
 0030   0006    '       R1           Row in which special graphics character
                 is displayed
 0030   0006    '       C1           Colum in which special graphics charac
                ter is displayed
 0030   0006    REM $PAGE
```



```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006
 0030   0006    'Main-line code for RJP Reagent Jet Printer
 0030   0006
 0030   0006    MAIN.LINE.CODE:
 0030   0006
 0030   0006            GOSUB INITIALIZE
 0043   0006
 0046   0006            WHILE TYPE1 <> 3
 0056   0008
 0056   0008                    TYPE1 = 0
 005D   0008                    A$ = ""
 0067   000C                    WHILE A$ = ""
 0076   000C                            A$ = INKEY$
 0080   000C                    WEND
 0083   000C
 0083   000C                    IF A$ = CHR$(0) + CHR$(72) THEN TYPE1 = 1:'
                up arrow
 0098   000C                    IF A$ = CHR$(0) + CHR$(80) THEN TYPE1 = 2:'
                down arrow
 00CD   000C                    IF A$ = CHR$(13) THEN TYPE1 = 3:'
                (cr) execute command
 00E7   000C
 00E7   000C                    ON TYPE1 GOSUB T1, T2, T3
 00F6   000C
 00F6   000C            WEND
 00FA   000C
 00FA   000C            CLS
 0101   000C            COLOR 7,0,0
 0112   000C            SYSTEM
 0116   000C
 0116   000C    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0116   000C    '******** SUB-ROUTINES FOR MAIN PROGRAM
 0116   000C    T1:     'up arrow
 011B   000C            IF MENU2 = 0 THEN RETURN
 012A   000E            DIFF2 = -1
 0131   0010            GOSUB NEW.MENU
 0137   0010            RETURN
 013B   0010
 013B   0010    T2:     'down arrow
 0140   0010            IF MENU2 = 5 THEN RETURN
 014F   0010            DIFF2 = 1
 0156   0010            GOSUB NEW.MENU
 015C   0010            RETURN
 0160   0010
 0160   0010    T3:
 0165   0010            ON MENU2 + 1 GOSUB T31, T32, T33, T34, T35, T36
 017C   0010            IF MENU2 < 5 THEN TYPE2 = 0:'   reset TYPE2 so progra
                    won't end
 013E   0010            SCREEN 0,0,3,3
 01A5   0010            RETURN
 01A9   0010
 01A9   0010    T31:    'pattern definition
 01AE   0010            CALL PATENTRY:          'in module PATENT
 01BA   0010            GOSUB REFRESH
 01C0   0010            RETURN
 01C4   0010
 01C4   0010    T32:    'pattern filing
 01C9   0010            SCREEN 0,0,0,0:CLS
 01E5   0010            CALL PATTERN.FILE:      'in module PATFILE
 01F1   0010            RETURN
 01F5   0010
 01F5   0010    T33:    'reagent calibration
 01FA   0010            CALL REAGENT.CALIBRATE:'in module REACAL
 0206   0010            RETURN
 020A   0010
 020A   0010    T34:    'reagent filing menu
 020F   0010            SCREEN 0,0,0,0:CLS
 022B   0010            CALL REAGENT.FILE:      'in module REAFILE
 0237   0010            RETURN
 023B   0010
 023B   0010    T35:    'print pattern
 0240   0010            CALL PATPRINT:          'in module PATPRINT
 024C   0010            RETURN
 0250   0010
 0250   0010    T36:    'exit system, don't reset TYPE2
 0255   0010            RETURN
 0259   0010
 0259   0010    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0259  0010  MEV.MENU:
025E  0010          GOSUB MENU.OFF
0264  0010          MENU% = MENU% + DIFF%
0270  0010          GOSUB MENU.ON
0276  0010          RETURN
027A  0010
027A  0010  INITIALIZE:
027F  0010          CALL PCI.INIT
0285  0010
028B  0010  '       define and initialize arrays
028B  0010          DIM MROW%(5)
028C  001C          MROW%(0) = 4
029E  001C          MROW%(1) = 6
02B1  001C          MROW%(2) = 10
02C4  001C          MROW%(3) = 12
02D7  001C          MROW%(4) = 16
02EA  001C          MROW%(5) = 20
02FD  001C
02FD  001C          DIM MENU$(5,1)
02FE  004C          RESTORE MENU.STRING.DATA
0305  004C          FOR IZ = 0 TO 5
030B  004C                  READ MENU$(IZ,0),MENU$(IZ,1)
033B  004E          NEXT IZ
034B  004E
034B  004E  '       set initial values into variables
034B  004E          TYPE% = 0
0352  004E          MENU% = 0
0359  004E
0359  004E  REFRESH: 'redraw screen and highlight current menu selection
035E  004E
035E  004E          SCREEN 0,0,0,0:CLS:COLOR 7,0,0
038B  004E          LOCATE 10,32:PRINT "Loading Menu....."
03A5  004E          SCREEN 0,0,3,0:CLS
03C2  004E
03C2  004E
03C2  004E          COLOR 13,0
03CE  004E          LOCATE 1,31
03DB  004E          PRINT "REAGENT JET PRINTER";
03EB  004E          COLOR 10,0
03F4  004E          LOCATE 5,26
0401  004E          PRINT "PATTERN"
040E  004E          LOCATE 11,26
041B  004E          PRINT "REAGENT"
0428  004E          LOCATE 16,26
0435  004E          PRINT "PRINTING"
0442  004E          LOCATE 20,27
044F  004E          PRINT "SYSTEM"
045C  004E
045C  004E  '       draw the menu table in special graphics characters
045C  004E          COLOR 9,0
0466  004E          FOR I% = 18 TO 62
046F  004E                  LOCATE 2,I%:PRINT "D";
048A  004E                  LOCATE 8,I%:PRINT "D";
04A5  004E                  LOCATE 14,I%:PRINT "D";
```

```
Offset  Data    Source Line
 04C0   004E            LOCATE 18,1%:PRINT "D";
 04DB   004E            LOCATE 22,1%:PRINT "D";
 04F6   004E            LOCATE 24,1%:PRINT "D";
 0511   004E        NEXT I%
 0524   004E        FOR I% = 3 TO 23
 052B   004E            LOCATE I%,17:PRINT "J";
 0546   004E            LOCATE I%,64:PRINT "J";
 0561   004E        NEXT I%
 0571   004E        RESTORE TABLE
 0578   004E        FOR I% = 1 TO 12
 057F   004E            READ R%,C%,C$
 0592   0056            LOCATE R%,C%:PRINT C$;
 05AE   0056        NEXT I%
 05BE   0056
 05BE   0056        print the instructions
 05BE   0056        COLOR 7,0
 05CA   0056        LOCATE 25,6
 05D7   0056            PRINT "Use   or   to highlight menu items.  Use     to
                    activate selection.";
 05E4   0056
 05E4   0056            COLOR 15,0
                    ";
 060A   0056            LOCATE 25,15:PRINT "";
 0624   0056            LOCATE 25,47:PRINT "DY";
 063E   0056
 063E   0056        '   display the 6 menu choices
 063E   0056            TEMP% = MENU%
 0645   0058            FOR MENU% = 0 TO 5
 064B   0058                GOSUB MENU.OFF
 0651   0058            NEXT MENU%
 0661   0058            MENU% = TEMP%
 0668   0058
 0668   0058        '   highlight the currently active menu item
 0668   0058            GOSUB MENU.ON
 066E   0058
 066E   0058            SCREEN 0,0,3,3
 0685   0058            RETURN
 0689   0058
 0689   0058    MENU.ON:'highlight the menu MENU% and display its long descript
                    ion
 068E   0058            COLOR 0,7
 069A   0058            LOCATE ARROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
 06DA   0058            PRINT MENU$(MENU%,0);
 06F6   0058            COLOR 7,0
 0704   0058            LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
 0738   0058            PRINT MENU$(MENU%,1);
 0757   0058            RETURN
 075B   0058
 075B   0058    MENU.OFF:'un-highlight menu MENU% and erase long description
 0760   0058            COLOR 14,0
 076C   0058            LOCATE ARROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
 07AC   0058            PRINT MENU$(MENU%,0);
 07CA   0058            COLOR 7,0
 07D6   0058            LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
```

Reagent Jet Printer
Main Line Code

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
060A  005B          PRINT SPACE$(LEN(MENU$(MENUX,1)));
062F  005B          RETURN
0833  005B
0833  005B    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  8
Main Line Code                                                         07-09-86
                                                                       15:27:04
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0833   0053    '******** DATA FIELDS USED BY THE MAIN PROGRAM ********
 0833   0058
 0833   0058    MENU.STRING.DATA:       'first entry is menu name, second is lo
                ng description
 0838   0058
 0838   0058            DATA "DEFINITION", "Create and Modify Patterns"
 083A   0053            DATA "FILING",     "Delete, Copy, Rename, and Select Pa
                tterns"
 083C   0058            DATA "CALIBRATION","Calibrate and Modify Reagent Profil
                es"
 083E   0058            DATA "FILING",     "Delete, Copy, Rename, and Select Re
                agents"
 0840   0058            DATA "PRINT",      "Print Selected Pattern with Selecte
                d Reagent"
 0842   0058            DATA "EXIT TO DOS","Leave Program and Return to DOS"
 0844   0058
 0844   0058    TABLE:  'first entry is row, second is column, third is special
                 graphics character
 0849   0058
 0849   0058            DATA 2,17,"2"
 084B   0058            DATA 2,64,"7"
 084D   0058            DATA 8,17,"C"
 084F   0058            DATA 8,64,"4"
 0851   0058            DATA 14,17,"C"
 0853   0058            DATA 14,64,"4"
 0855   0058            DATA 18,17,"C"
 0857   0058            DATA 18,64,"4"
 0859   0058            DATA 22,17,"C"
 085B   0058            DATA 22,64,"4"
 085D   0058            DATA 24,17,"2"
 085F   0058            DATA 24,64,"Y"
 0861   0058
 0861   0058            END
 0865   0058
 0842   0058

50426 Bytes Available
47680 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:

a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;

a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and

means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;

at least one additional transducer in mechanical communication with the additional jetting chamber;

at least one additional means for applying an electrical pulse to the additional transducer;

means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the diagnostic fluids to be dispensed in a desired volumetric ratio; and

a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted addi-tional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the trans-ducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with a hydrophobic polymer.

11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected rise and fall time constants and of selected duration. voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted diagnostic fluid along a desired path.

15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice in the chamber; and

(c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed

FIG. 1

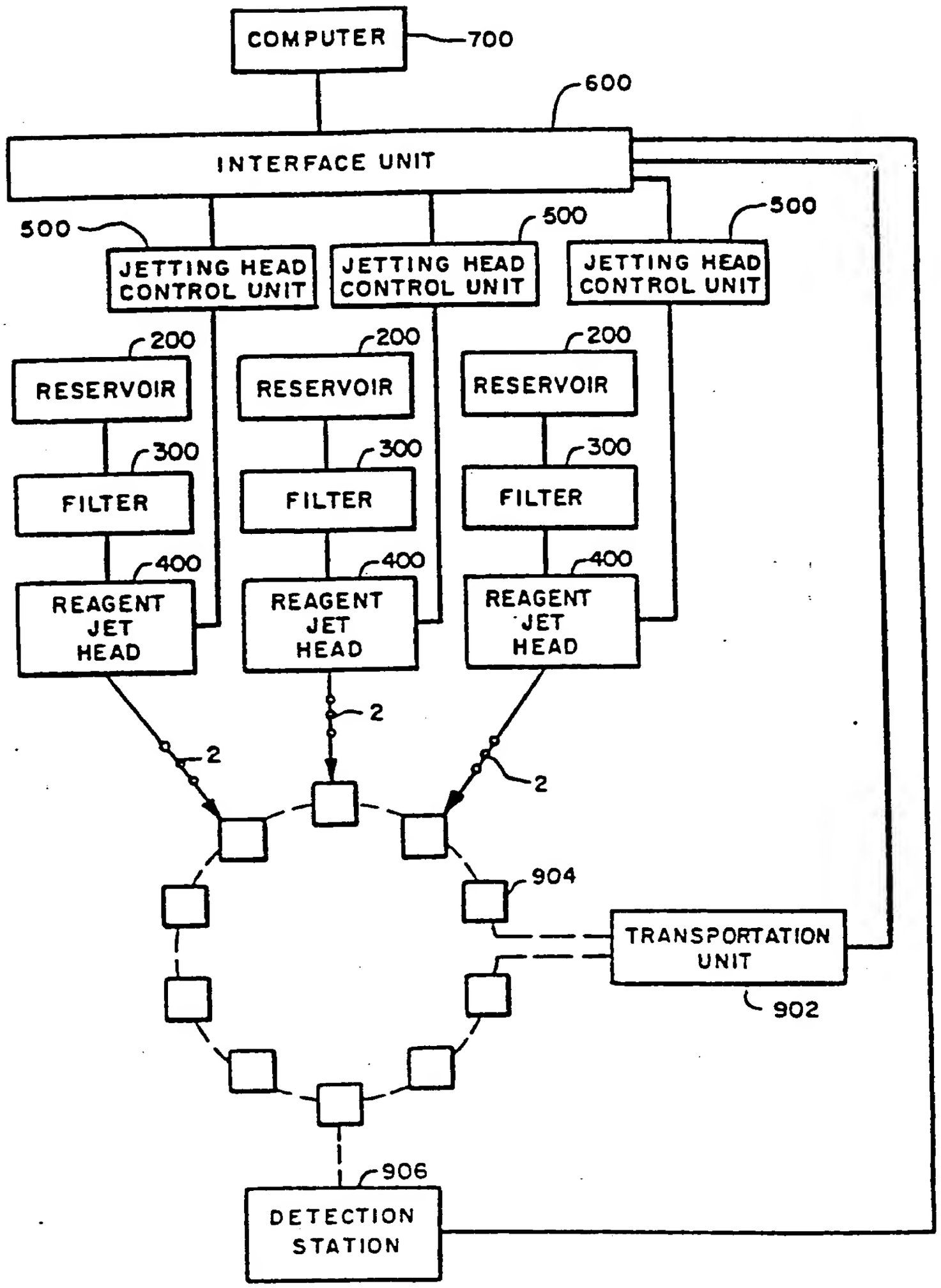

COMPUTER
700
600
INTERFACE UNIT
500
500
500
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
200
200
200
RESERVOIR
RESERVOIR
RESERVOIR
300
300
300
FILTER
FILTER
FILTER
400
400
400
REAGENT JET HEAD
REAGENT JET HEAD
REAGENT JET HEAD
2
2
2
904
TRANSPORTATION UNIT
902
906
DETECTION STATION

FIG. 2a

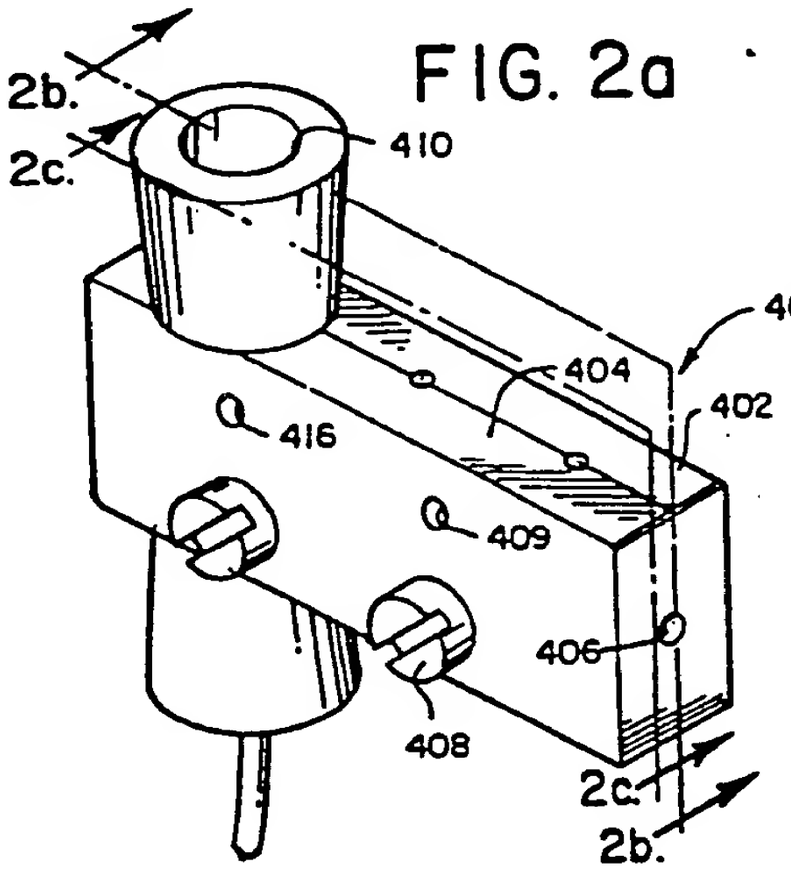


FIG. 2b

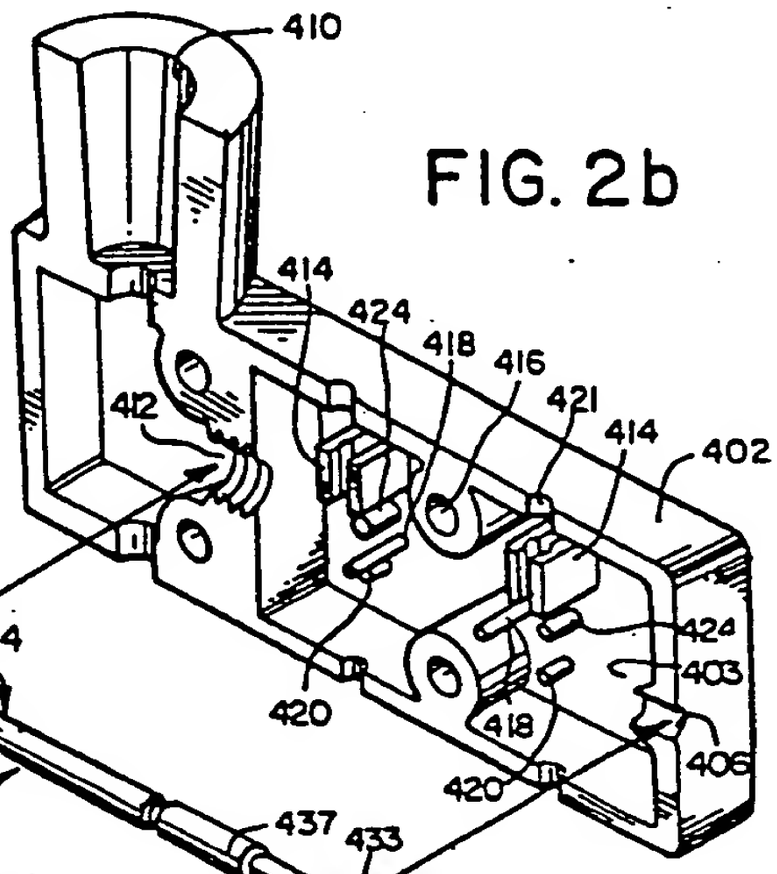
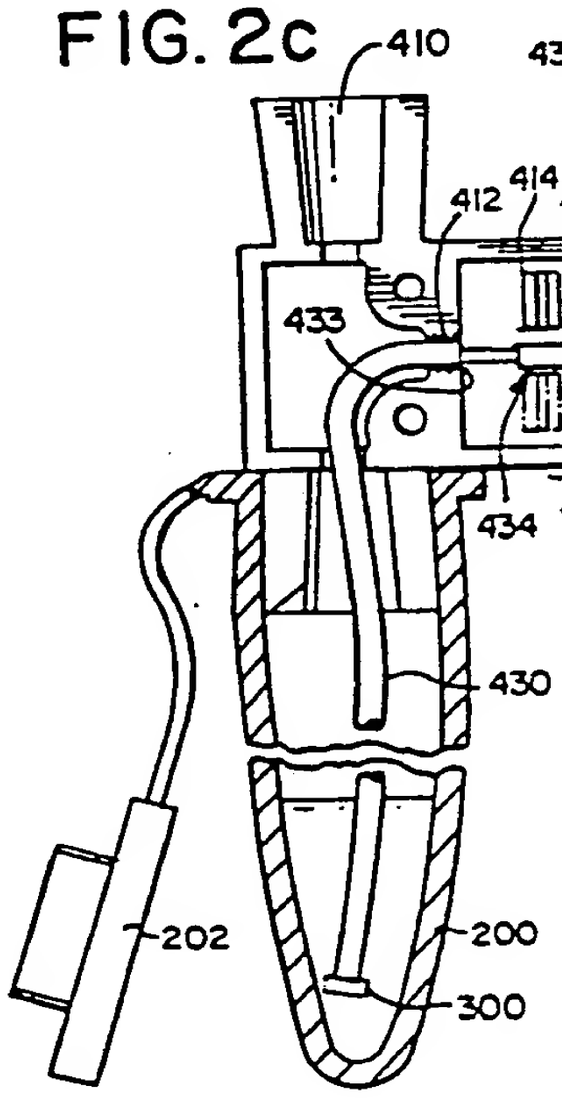


FIG. 2c



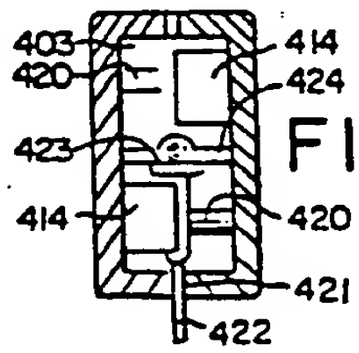


FIG. 2d

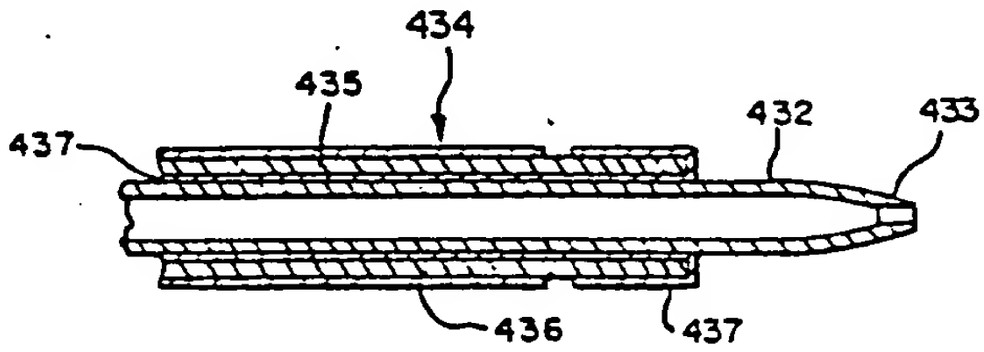
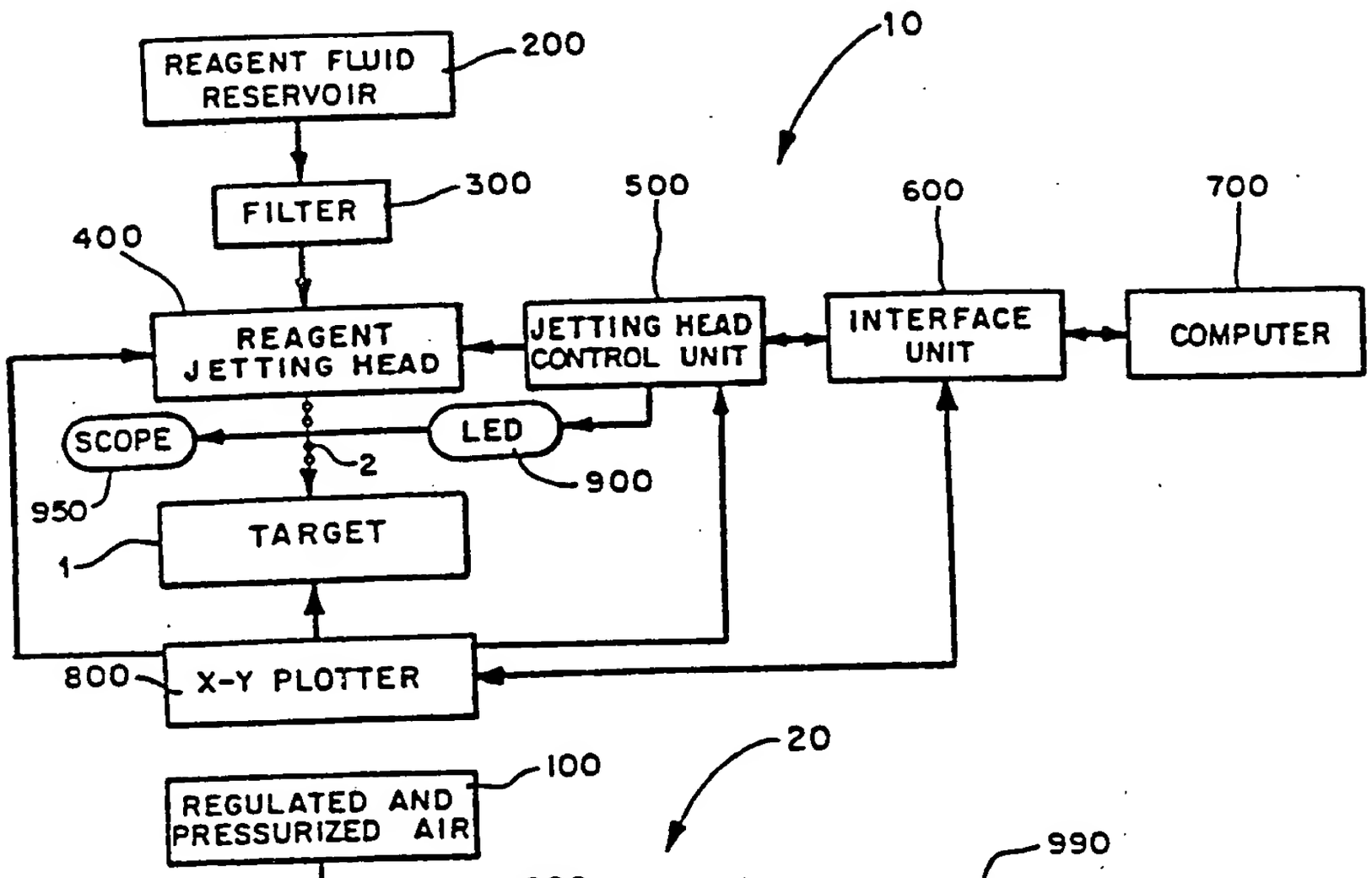


FIG. 2e

FIG. 3


10
REAGENT FLUID RESERVOIR
200
FILTER
300
500
600
700
400
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
SCOPE
LED
2
900
950
TARGET
1
800
X-Y PLOTTER

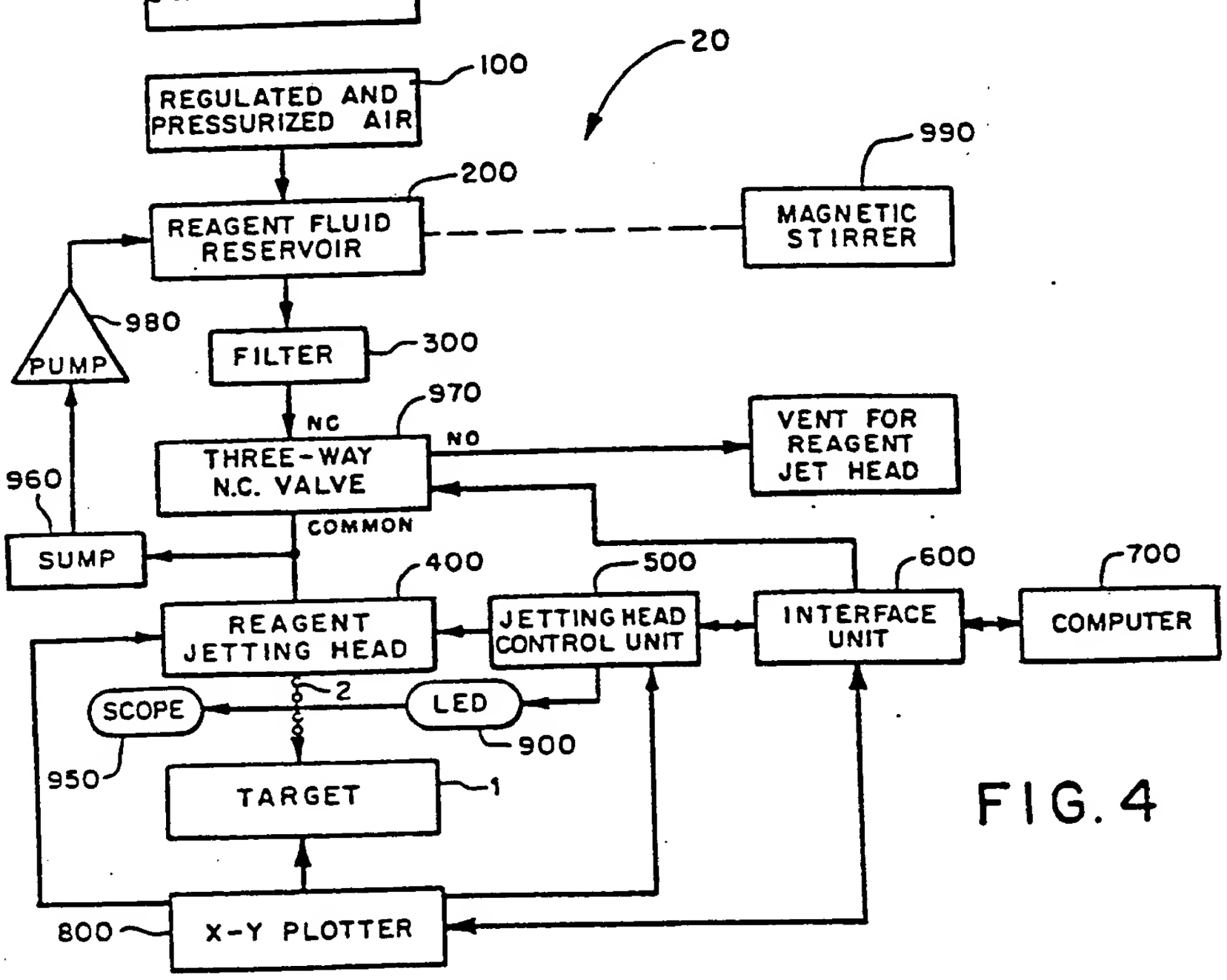

20
REGULATED AND PRESSURIZED AIR
100
REAGENT FLUID RESERVOIR
200
990
MAGNETIC STIRRER
PUMP
980
FILTER
300
970
NC
NO
THREE-WAY N.C. VALVE
VENT FOR REAGENT JET HEAD
960
COMMON
SUMP
400
500
600
700
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
2
SCOPE
LED
900
950
TARGET
1
800
X-Y PLOTTER

FIG. 4

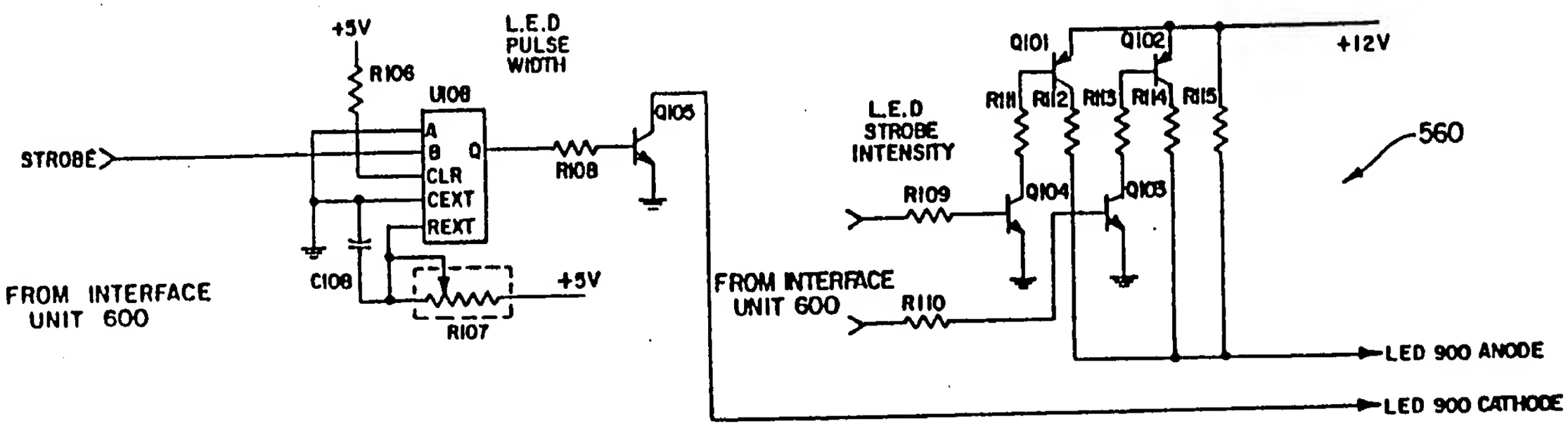


FIG. 5a

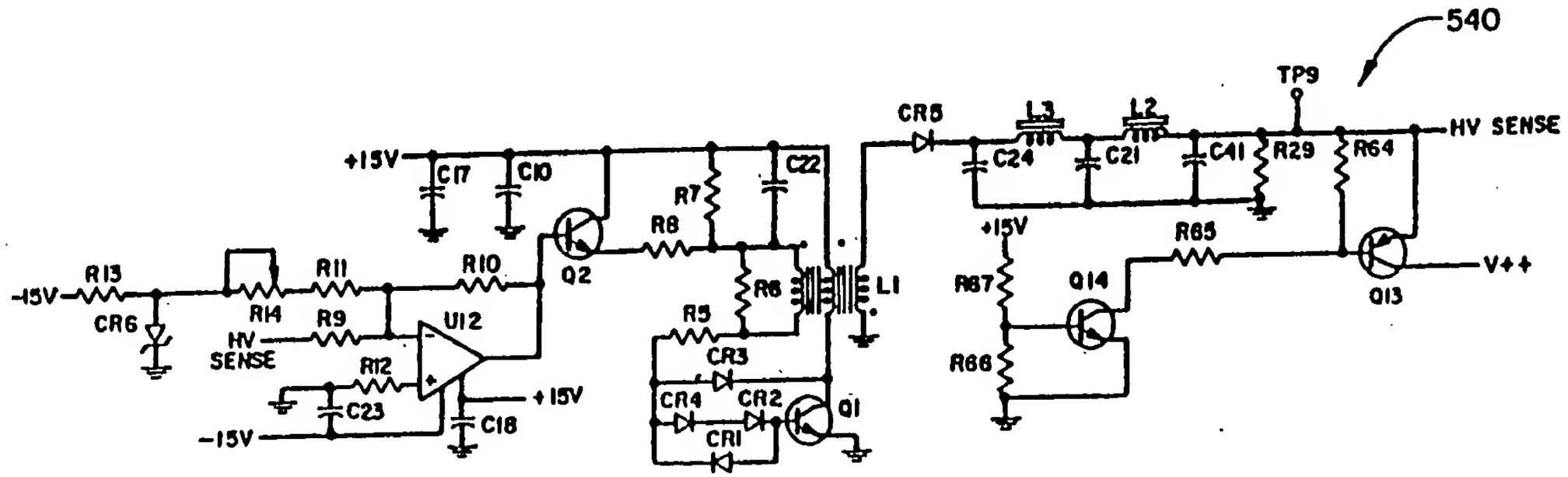


FIG. 5b

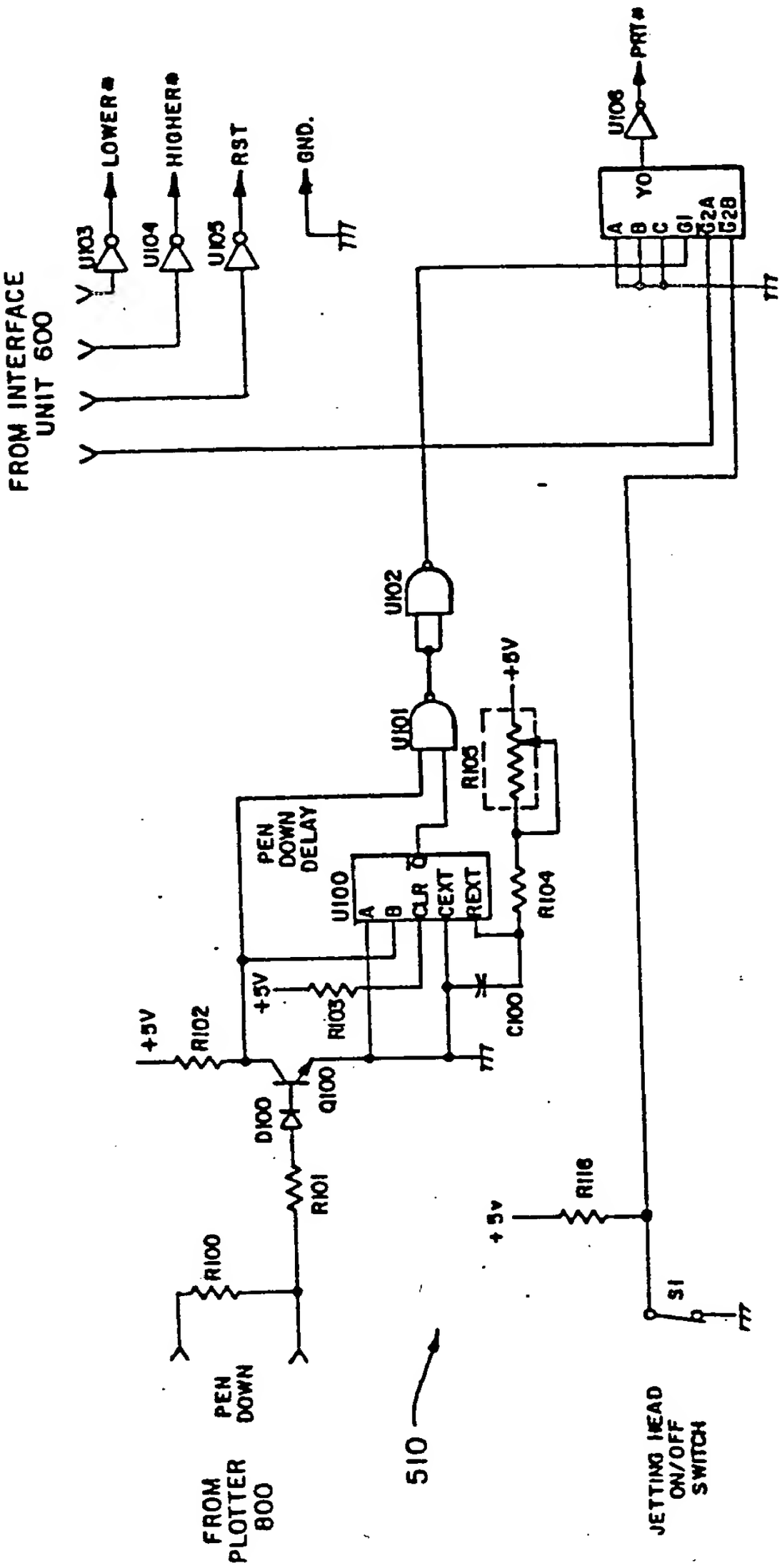

FROM INTERFACE UNIT 600
U103
U104
U105
LOWER*
HIGHER*
RST
GND.
U106
PRT*
A
B
C
G1
G2A
G2B
Y0
U102
U101
R105
+5V
PEN DOWN DELAY
U100
CLR
CEXT
REXT
R104
R103
C100
R102
Q100
D100
R101
R100
R116
S1
FROM PLOTTER 800
PEN DOWN
510
JETTING HEAD ON/OFF SWITCH

FIG. 5c

FIG. 5d

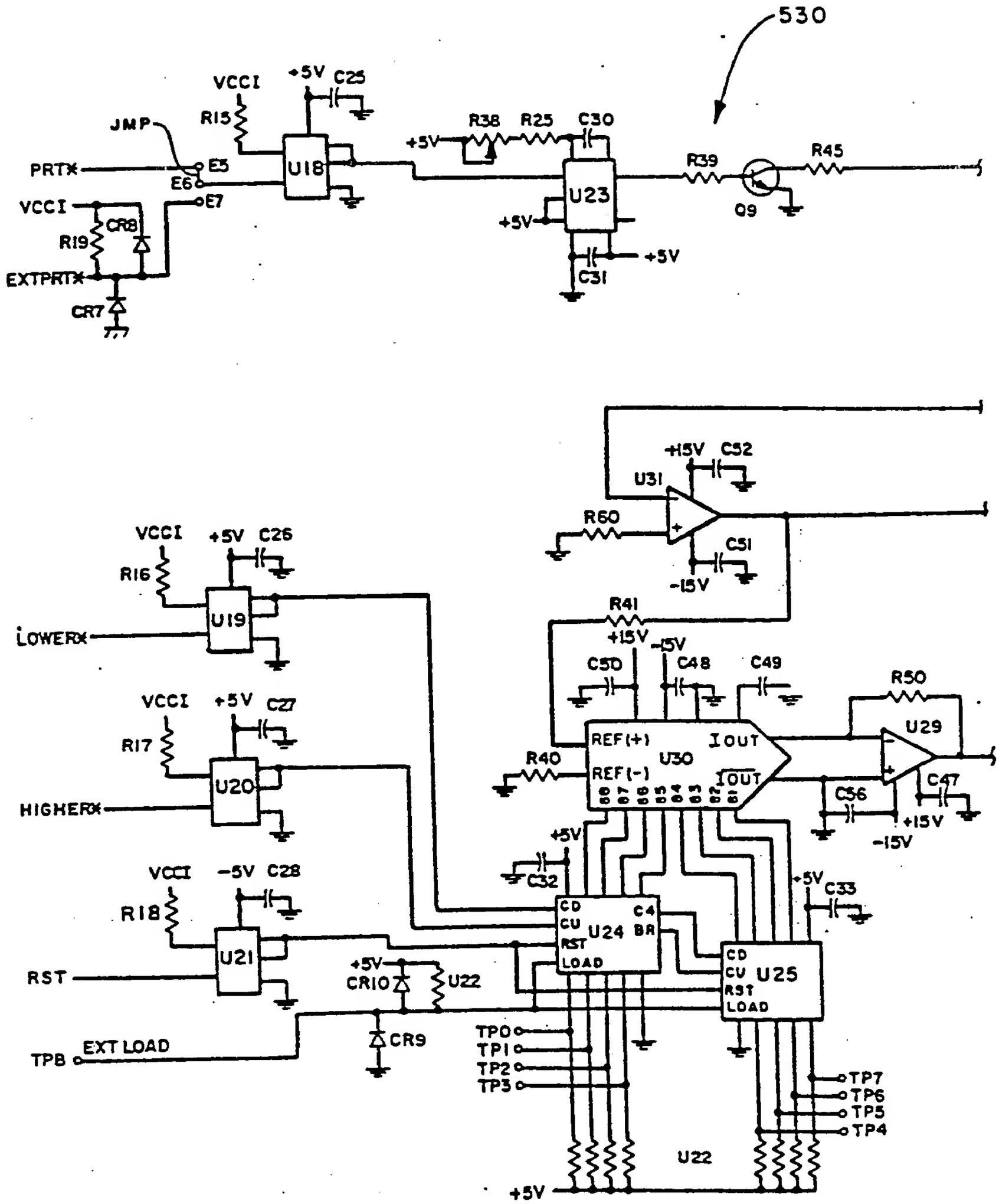

530
VCCI
+5V
C25
R15
JMP
PRTX
E5
E6
E7
U18
VCCI
R19
CR8
EXTPRTX
CR7
+5V
R38
R25
C30
R39
R45
Q9
U23
+5V
C31
+5V
+15V
C52
U31
R60
C51
-15V
R41
+15V
-15V
C50
C48
C49
R50
U29
REF(+)
REF(-)
U30
IOUT
IOUT
R40
C56
C47
+15V
-15V
+5V
C32
+5V
C33
VCCI
+5V
C26
R16
U19
LOWERX
VCCI
+5V
C27
R17
U20
HIGHERX
VCCI
-5V
C28
R18
U21
RST
+5V
CR10
U22
CR9
TPB
EXT LOAD
CD
CU
RST
LOAD
U24
BR
C4
CD
CU
RST
LOAD
U25
TP0
TP1
TP2
TP3
TP7
TP6
TP5
TP4
U22
+5V

FIG. 5e

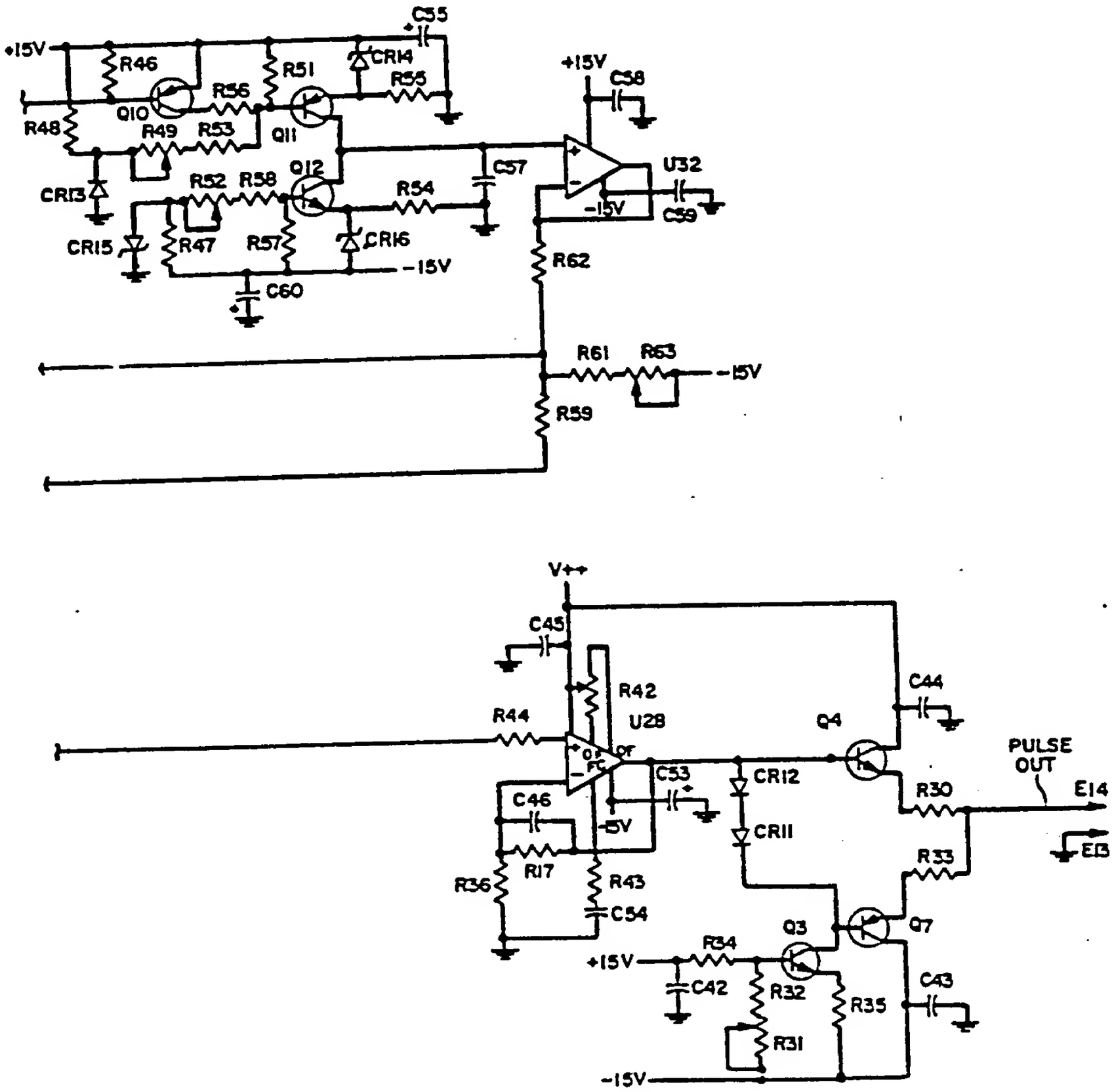

+15V
R46
R56
Q10
R48
R49
R53
Q11
CR13
R52
R58
Q12
CR15
R47
R57
CR16
-15V
C60
C55
CR14
R55
R51
C57
R54
+15V
C58
U32
-15V
C59
R62
R61
R63
-15V
R59
V++
C45
R42
R44
U28
C46
R17
R36
R43
C54
C53
CR12
CR11
-15V
Q4
C44
PULSE OUT
E14
E13
R30
R33
Q7
Q3
R34
+15V
C42
R32
R31
R35
C43
-15V

FIG. 6a

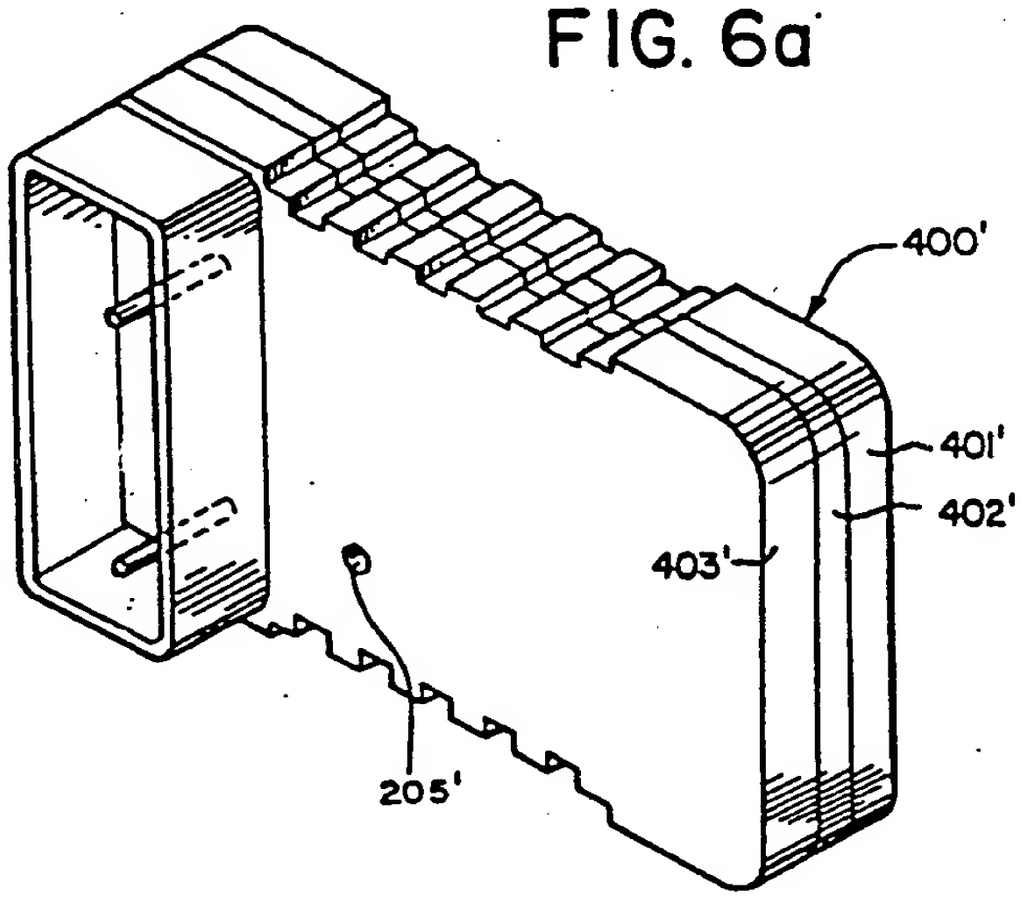


FIG. 7

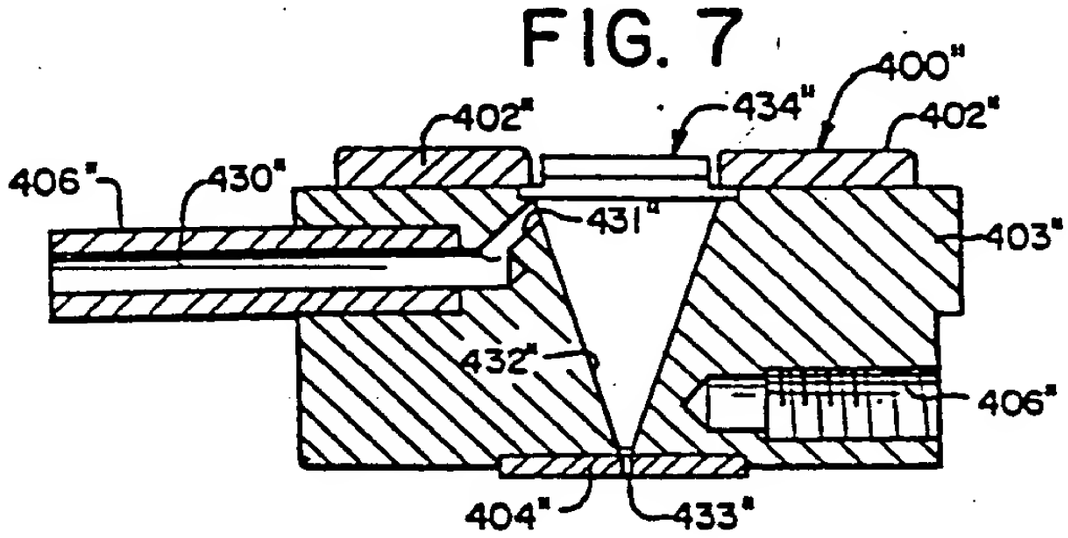
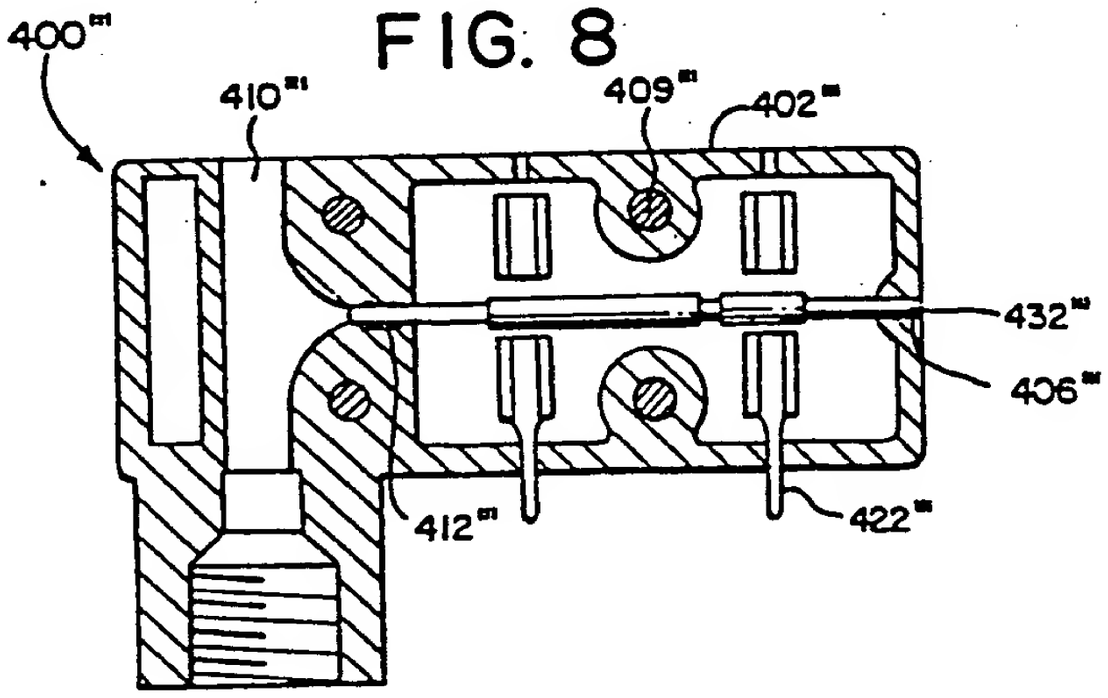


FIG. 8



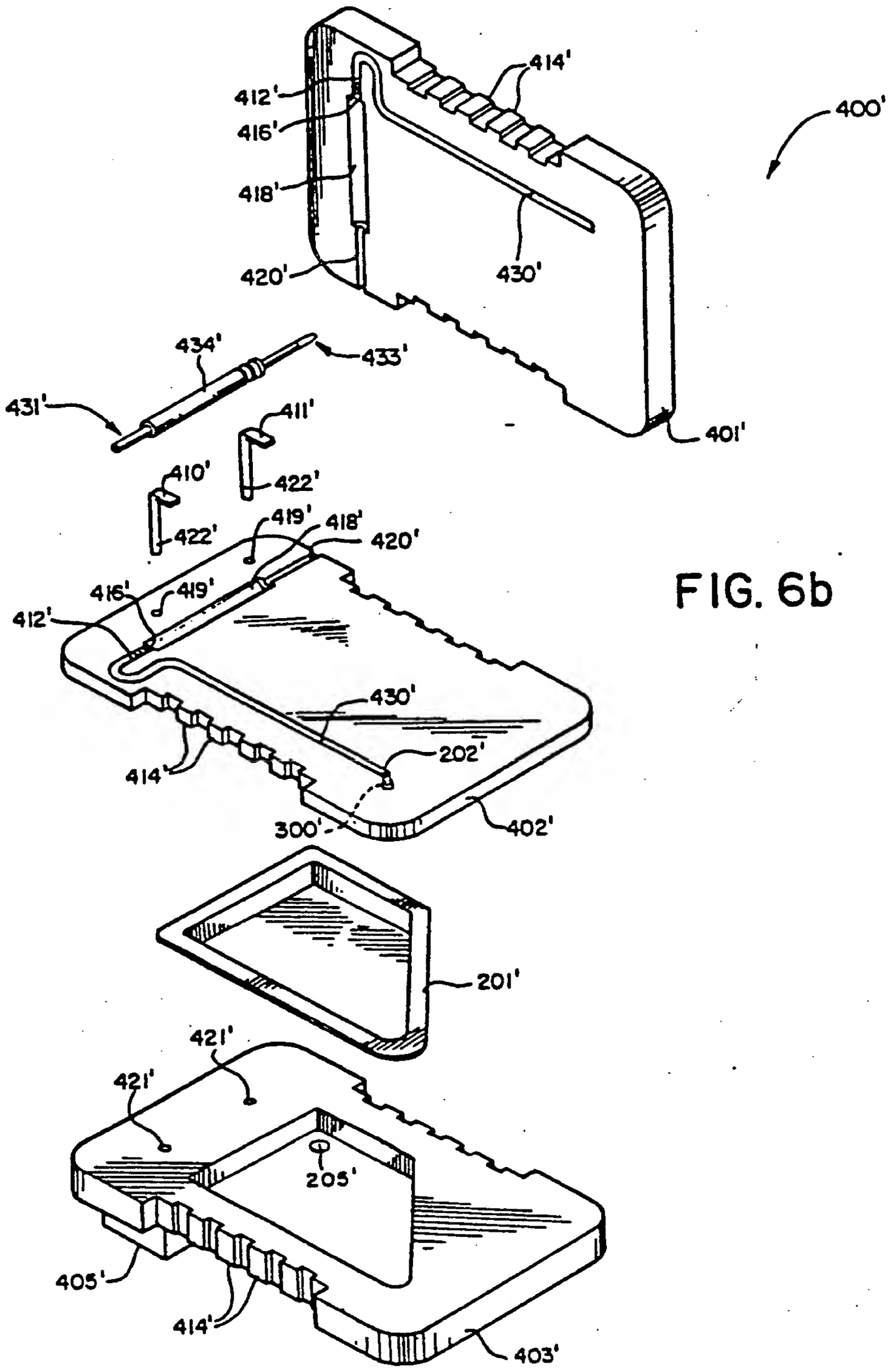

414'
412'
400'
416'
418'
420'
430'
401'
434'
433'
431'
411'
410'
422'
422'
419'
418'
420'
416'
419'
412'
430'
202'
414'
300'
402'
201'
421'
421'
205'
405'
414'
403'

FIG. 6b

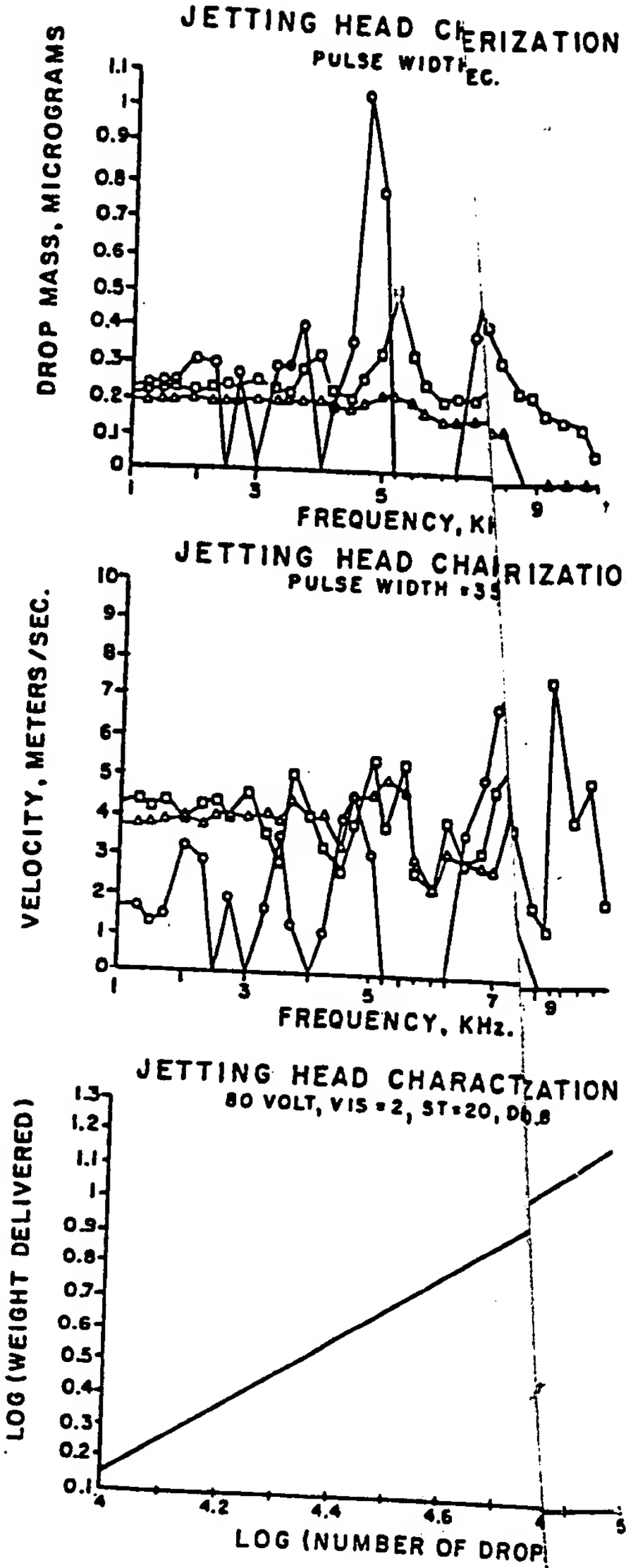


FIG. 9

□ VIS = 5CP
○ VIS = 1 CP
△ VIS = 24CP

FIG. 10

VIS = 5CP
VIS = 1CP
VIS = 24CP

FIG. 11